

# Effectiveness of Computer-Based Instruction On Academic Performance of Pre-Degree Students In Biology, Abdullahi, Shuaibu

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## Abstract

This study determined the effectiveness of computer-based instruction on the academic performance of pre-degree students in Biology in Modibbo Adama University of Technology, Yola. One research question and three null hypotheses tested at 0.05 level of significance guided the study. The researchers studied the entire population of 220 students. The design of the study was quasi-experimental, specifically the non-equivalent control group design. The instrument for data collection was a Biology Achievement Test composed of 50 objective test items. The instrument was both face and content validated and test-retest method was used to estimate the reliability. The Pearson product moment correlation method was used to calculate the reliability coefficient of first and second administration of the test which gave a coefficient of stability of 0.76. The t-test was used to test the hypotheses at 0.05 level of significance. Result shows that the students taught with computer-based instruction performed better than those taught with conventional lecture method ( $p > 0.05$ ) because there was significant difference between the performance of the two groups. It was recommended among others that computer-based instruction be used to teach biology because it enhanced students' academic performance.

## Introduction

This study centered on the pre-degree science programme of the Modibbo Adama University of Technology (MAUTECH) Yola formerly the Federal University of Technology (FUTY). The pre-degree science programme was established in the institution to prepare students in the sciences, preparatory to their entry into the five-year degree programme of the university. The programme was established in 1986 and became operational in May, 1987 under the name Remedial year programme (Abdullahi, 2009). The programme is designed for candidates who for one reason or the other could not gain admission into the University through the University Matriculation Examination (UME) now Unified Tertiary Matriculation Examination (UTME). The pre-degree programme which was later named pre-degree science programme lasts for one academic year. The programme is mounted in Biology, Chemistry, Physics, Mathematics, Technical Drawing and Geography.

The pre-degree science programme has gained recognition in the society because of the tremendous increase in the admission. From 1999/2000 to 2007/2008 sessions, the admission statistics stood at 4,316 in the six science subjects while the enrolment for Biology was 1,764 students. The pre-degree science programme is delivered using the conventional lecture method in most cases (Abdullahi, 2009). Going by the performance of students in Biology (Science of life), literature revealed that the performance has been poor (Abdullahi, 2009). From 1999/2000 to 2001/2005, 1764 students had sat for pre-degree Biology examination and only 37% had credit passes (50%-70%) (Abdullahi 2009).

In general, different instructional strategies are employed in the teaching of a subject in order to achieve desired learning outcomes (Ojo, 2006). According to Ngada (2004), the choice of a particular method by instructors is dependent on criteria such as type of subject, instructional objective, age of students and availability of materials. The lecture method which is used to deliver much of learning experiences is a traditional or conventional lecture method (CLM) of teaching. The method is used to deliver facts and principles to a large number of students. The method does not encourage much of teacher-student interactions, so students active participation in a lesson is low using the method. In specific terms the teacher is active while the students remain passive during classroom activities. The method is usually called chalk and talk method of teaching.

The computer-based instruction (CBI) which is the main effect in this study is an innovative method of teaching which according to Brown (1997) is an instructional strategy which uses the computer to deliver instructions to students. The CBI is a broad term which can be described as computer-assisted instruction for educational settings for drill and practice, tutorials, simulations, animations, instructional management, supplementary exercises, data programming and word processing (Brown, 1997). Terms like: computer-assisted instruction (CAI), computer-enriched instruction (CEI), computer-managed instruction (CMI) and computer-

assisted learning (CAL) are used interchangeably with CBI in teaching-learning process. Cotton (1991) reported effect of CBI on students' achievement, attitudes and other variables such as learning rate and retention and found out that CBI is a supplement to lecture/teacher-directed (conventional) instruction whose achievement effect is superior to those obtained in CLM. The researcher found out that the use of CBI as an instructional delivery method positively influenced students' learning rate. Copper and Copple (1985) compared the instructional implications of the use of CBI and conventional methods on students' learning rate and found out that learning rate was as much as 40% in favour of CBI. Abdullahi (2009) found out that the performance of students in the experimental group taught with CBI, using micro-computer was higher than those of control group taught with CLM in animal diversity, plant diversity and cell biology at 0.05 level of significance.

The CBI being effective in instructional delivery as literature revealed may be of benefit in improving the pre-degree science students' performance in biology but this notwithstanding, a comparison would be made in this study between the performance of pre-degree biology students using CBI with micro-computer and CLM. The problem of this study is: what would be the effectiveness of CBI and CLM on academic performance of pre-degree science students in Biology? The biology topics used for the study were animal diversity, plant diversity and cell biology. Animal diversity deals with varieties of animals, plant diversity deals with varieties of plants while cell biology concerns structure and functions of cells.

#### **Purpose of the Study:**

The general purpose of the study was to investigate the effectiveness of CBI on academic performance of pre-degree science students in biology. The specific purposes of the study were to determine:

1. the performance of pre-degree students' in animal diversity when taught using CBI and conventional lecture method.
2. the performance of pre-degree students in plant diversity when taught using CBI and conventional lecture method.
3. the performance of pre-degree students in cell biology when taught using CBI and conventional lecture method.

#### **Research Question:**

1. What is the pre-test scores of the students used for the study in animal diversity, plant diversity and cell biology?

#### **Hypotheses:**

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study.

- H<sub>01</sub>: There is no significant difference between the mean achievement scores of pre-degree experimental group taught animal diversity with CBI and the control group taught with conventional lecture method.
- H<sub>02</sub>: There is no significant difference between the mean achievement scores of pre-degree experimental group taught plant diversity with CBI and the control group taught with conventional lecture method.
- H<sub>01</sub>: There is no significant difference in the mean achievement scores of pre-degree experimental group taught cell biology with CBI and the control group taught with conventional lecture method.

#### **Research Method:**

The research design adopted for the study was quasi-experimental design of non-equivalent control group design. The design was adopted because subjects were not randomly assigned to groups, instead intact classes were used and randomly assigned to experimental and control groups. The design was also used because very few school authorities would allow a researcher to disrupt their normal school activities if true experimental research design was used (Sambo, 2005). The diagrammatic sketch of the design is:

G<sub>1</sub>: Y<sub>11</sub> X            Y<sub>21</sub>

G<sub>2</sub>: Y<sub>12</sub> \_            Y<sub>22</sub>

Where: G<sub>1</sub> = Experimental group

Y<sub>11</sub> = Pretest mean scores of the experimental group

X = Treatment

Y<sub>21</sub> = Post-test mean performance of experimental group

G<sub>2</sub> = Control group

Y<sub>12</sub> = Mean performance of pre-test of control group

Y<sub>22</sub> = post-test mean performance of the control group

\_ = no treatment for control group (Sambo,2005)

G<sub>1</sub> = Group 1

G<sub>2</sub> = Group 2

The population of the study was 220 pre-degree students who registered for Biology in the programme in 2011/2012 session. These students are senior school certificate holders who had studied biology in their secondary school years. The pre-degree Biology students receive their lectures in two groups (Groups 1 and 2) due to insufficient lecture rooms to accommodate all of them in one lecture theatre. As a result, each group represented an intact class. Using a lucky dip sampling technique, group 1 consisting of 110 students was used as experimental group while group 2 with 110 students also was control group.

The instrument for data collection was 50 Biology Achievement Test (BAT) composed of objective test items in the three biology topics used for the study made up of four sections namely:

Section A: Fill in the blank spaces

Section B: True or false items

Section C: Multiple choice items

Section D: Matching items

Initially, 59 questions were constructed composed of 32 questions on animal diversity, 17 on plant diversity while 15 questions were set on cell biology. The BAT was given to three experts, one each from the Departments of Biological Sciences and Science Education (Biology) for face and content validation. The third expert was in educational measurement and evaluation. The face validation required the validators to assess the instrument in terms of appropriateness of the test, clarity of expression and correctness of the answers to the questions. The content validation required the experts to check the content coverage of the items against the course outline used for teaching the course and the table of specification constructed for the test. The item difficulty and item discrimination indices were carried out through pre-testing to collect data and the use of appropriate statistical techniques. The item difficulty and discrimination indices were calculated for each item using 27% cut off for upper and lower class of testees that scored the item correct. Items were selected for use if they satisfied the following conditions: an item difficulty index ranging from 0.26-0.81 and item discrimination index from +0.22 and above. Using these criteria, 50 questions were selected consisting of 27 questions from animal diversity, 13 questions from plant diversity while 10 questions were picked from cell biology. The construction of the questions was guided by the relative emphasis on each of the topics on the course outline used for teaching the topics. Questions from each topic were distributed in the sections A-D without exceeding the number of questions from a particular topic.

Test-retest method was used to estimate the reliability of BAT. Thirty pre-degree Biology students from Abubakar Tafawa Balewa University, Bauchi were used to collect data for estimating the reliability of the test during pilot study. A gap of two weeks was given between the first and second administrations of the test (Test 1 and Test 2). Pearson product moment correlation was used to correlate the first and second scores obtained from the two test administrations. A coefficient of stability of 0.76 was obtained as reliability coefficient of BAT.

Experimental procedure: Pre-test was administered on both the experimental and control groups using the BAT before the commencement of the experiment. The researchers trained two research assistants that helped to carry out the experiment by teaching the groups. At the on-set of the treatment the experimental group (group 1) was taught the biology topics with microcomputer by one research assistant while the control group (group 2) was taught by the other research assistant without microcomputer rather with conventional lecture method. The two groups were taught in different lecture theatres far away from each other on the same day and the same time in order to avoid contamination of treatment if the groups were taught at nearby lecture theatres at the same time or on different days. Some students may be curious to know what is happening in the lecture theatre outside their own. The experiment lasted for four weeks and post-test was administered on the groups.

Some extraneous variables that could affect the study were controlled. The researchers prepared the lesson plans used for the study to ensure uniformity and acceptable standard. The colour of the question paper was changed from white to yellow while the serial number of the questions were reversed in order to take care of history and maturation. The Hawthorne effect in which the students developed a conscience that they were not involved in an experiment by using their regular teachers in the treatment was also employed. Time table was prepared for monitoring by the researchers since the researchers were not engaged in teaching.

## **Result**

The following results were obtained from the study:

Research Question 1: What is the pre-test scores of students used for the study in animal diversity, plant diversity and cell biology?

Table 1: Pre-test results of experimental and control groups used for the study.

| S/N | Topics           | Groups             | N   | $\bar{x}$ | SD  | Mean ( $\bar{x}$ ) difference |
|-----|------------------|--------------------|-----|-----------|-----|-------------------------------|
| 1.  | Animal diversity | Experimental group | 110 | 10.0      | 5.0 | 0.2                           |
|     |                  | Control            | 110 | 9.8       | 4.8 |                               |
| 2.  | Plant diversity  | Experimental group | 110 | 2.2       | 2.6 | 0.3                           |
|     |                  | Control group      | 110 | 2.5       | 2.3 |                               |
| 3.  | Cell biology     | Experimental group | 110 | 2.8       | 3.6 | 0.2                           |
|     |                  | Control group      | 110 | 2.6       | 2.9 |                               |

Table 1 shows the pre-test results of the students used for the study in animal diversity plant diversity and cell biology. The mean difference between experimental and control groups in animal diversity was 0.2, that of plant diversity was 0.3 and in cell biology the gap was 0.2. These results reveal that the students both experimental and control have relatively equal academic background due to small difference in their mean performance.

**H<sub>01</sub>:** There is no significant difference in the mean achievement scores of pre-degree experimental group taught animal diversity with CBI and the control group taught with conventional lecture method.

Table 2: t-test Analysis of the Results of experimental and control groups in the pre-degree Biology test

| Group         | n   | $\bar{x}$ | SD   | DF  | t-cal | t-crit | Remarks     |
|---------------|-----|-----------|------|-----|-------|--------|-------------|
| Experimental  | 110 | 24.59     | 6.82 | 218 | 4.79  | 1.960  | Significant |
| Control group | 110 | 21.00     | 4.02 |     |       |        |             |

The result in Table 2 indicates a t-value of 4.79 at 0.05 level of significance which is greater than the t-critical value of 1.960. As a result, H<sub>01</sub> is rejected because a significant difference exists between the performance of the two groups in favour of the experimental group in the Biology Achievement Test on animal diversity.

**H<sub>02</sub>:** There is no significant difference between the mean achievement scores of pre-degree experimental group taught plant diversity with CBI and the control group taught with conventional lecture method

Table 3: t-test Analysis of the Result of students taught plant diversity with CBI (experimental group) and the control taught with conventional lecture method.

| Groups        | n   | $\bar{x}$ | SD   | Df  | t-cal | t-crit. | Remarks     |
|---------------|-----|-----------|------|-----|-------|---------|-------------|
| Experimental  | 110 | 8.18      | 3.42 | 218 | 3.92  | 1.960   | Significant |
| Control group | 110 | 6.65      | 2.23 |     |       |         |             |

Result in Table 3 shows that t-calculated (3.92) is greater than t-critical (1.96) at 0.05 level of significance. This implies that there is significant difference in the performance of the two groups in the biology test on plant diversity in favour of the experimental group. Therefore, H<sub>02</sub> is not accepted.

**H<sub>03</sub>:** There is no significant difference between the performance of pre-degree students taught cell biology with CBI and the control group taught with the conventional lecture method.

Table 4: t-test Analysis of the Results of students taught cell biology with CBI and the control group taught with conventional lecture method.

| Groups       | n   | $\bar{x}$ | SD   | Df  | t-cal | t-crit | Remark      |
|--------------|-----|-----------|------|-----|-------|--------|-------------|
| Experimental | 110 | 8.22      | 3.58 | 218 | 3.85  | 1.960  | Significant |
| Control      | 110 | 6.61      | 2.52 |     |       |        |             |

The result presented in Table 4 indicates that t-calculated is greater than t-critical at 0.05 level of significance. This implies that there is significant difference between the two groups in their performance in favour of the experimental group. H<sub>03</sub> is rejected.

**Summary of Major Findings of the Study:** The following major findings resulted from the study:

1. Pre-degree students in the experimental group taught animal diversity with CBI performed better than the control group taught with conventional lecture method.
2. Pre-degree students in the experimental group taught plant diversity with CBI performed better than the control group taught with conventional lecture method.
3. Pre-degree students in the experimental group taught cell biology with CBI performed better than the control group taught with conventional lecture method.

#### **Discussion of the Findings:-**

The result of the study revealed that pre-degree students taught the biology topics in animal diversity, plant diversity and cell biology with CBI performed better than the control taught with conventional lecture method. This finding agreed with the findings of cotton (1991) that the effect of CBI on students' achievement, attitudes and other variables such as learning rate and retention was that CBI is supplement to lecture. This is because the achievement effect was superior to those obtained with CLM. In addition, the use of CBI as an instructional delivery method positively influenced students' learning rate. The findings of the study also agreed with that of Abdullahi (2009) that the performance of pre-degree students taught with CBI (experimental group) was higher than those of control group taught with CLM in animal diversity, plant diversity and cell biology as shown in Tables 2, 3 and 4 .

The effectiveness of CBI in improving students' achievement when compared ,with the control group could be as a result the fact that CBI is an innovative method which is used in educational setting for drill and practice, tutorials, simulations, instructional management, supplementary exercises, data programming and word processing (Brown, 1997). The implication is that CBI encourages active participation of students in a lesson through a lot of teaching-learning exposures which embodied teacher-student interaction. Through such interactions also, the students learned more, did more exercises and tutorials which enabled them to do better than the control group that was taught without CBI rather with conventional lecture method. The conventional lecture method is a traditional method of teaching which does not encourage students' active participation in a lesson as students remain passive while the teacher is active. Therefore, CLM being teacher-dominated reduces teacher-student interaction which may have accounted for the control group's poor performance in the test.

#### **Conclusion**

The computer-based instruction is an effective strategy for teaching and learning because it enhanced students' performance. Pre-degree students taught with the strategy performed better than the control taught with conventional lecture method in animal diversity, Plant diversity and cell biology. From the results of this study therefore it can be concluded that computer-based instruction is result-oriented and more effective in teaching biology than CLM.

#### **Recommendations:-**

The following recommendations resulted from the findings of this study:-

1. Computer – based instruction should be used in the teaching of pre-degree animal diversity, plant diversity and cell biology.
2. The conventional lecture method should be reduced for the teaching of pre-degree animal diversity, plant diversity and cell biology.

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