

Relative Effectiveness Of Paper-Pencil Based Test And Computer-Based Test On Senior Secondary School Year Two Students' Achievement In Computer Studies

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Abstract: The study examined the relative effectiveness of paper-pencil based test and computer-based test on senior secondary year two students' achievement in computer studies. Two research questions guided the study and three hypotheses were tested. The quasi-experimental design was adopted. Population of the study consisted of 2667 SS2 students. 74 students from two co-educational secondary schools were involved in the study. One instrument, the Computer Achievement Test (CBT) was used for the study. The instrument was validated by three experts. Reliability of CAT was using kuder Richardson formula 20 (KR-20) which yielded coefficient of 0.83. The two groups were given pre-test after which both the experimental groups were taught computer studies. The treatment lasted for four weeks and posttest was given at the end. PPT and CBT was used to assess the students. One group of the students was assessed with PPT and the other with CBT. Data collected were analyzed using mean and standard deviation to answer the research questions while ANCOVA were used to test the null hypotheses at 0.05 level of significance. Findings of the study revealed that there is a significant difference between students' assessed using PPT and CBT in favour of those assessed using PPT. It was recommended that more time be allowed to orient students on CBT before making it the only assessment test mode.

Keyword: computer-based test, paper and pencil test, computer studies, effectiveness, assessment

I. INTRODUCTION

In a developing country like Nigeria, educational system is perpetually under pressure to respond to the ever occurring changes in technology and improved understanding of scientific principles. The difference in achievement of students in Nigeria has been and is still a source of concern and research interest to educators, government and parents. Academic achievement is an important academic factor in Education. Academic achievement is the outcome of education. It is the extent to which a student, teacher or institution has achieved their educational goals. It is commonly measured through examination or continuous assessment, but there is no general agreement on how it is best tested or which aspects are most important.

Achievement test questions are used to assess a person's performance in a course of study which one has undergone.

Assessment is central to the practice of education. For students, good performance on 'high-stakes' assessment gives access to further educational opportunities and employment. Assessment systems provide the ways to measure individual and institutional success, and so can have a profound driving influence on systems they were designed to serve. Presently, the predominant mode of student's assessment in Nigeria is the traditional method. In this method, students are assessed using paper and pen on cognitive abilities. This traditional method of assessment has imposed serious limitations to the effectiveness of the method.

The traditional method is characterized by various forms of examination malpractices such as bringing in unauthorized materials, writing on currency notes and identity cards, spying on other candidates in examination hall, substitution of answer sheets and change of examination scores or grades. Others include, impersonation, leakage of questions to students before

the examination, conniving with supervisors and school authorities to cheat and among others. The threat of examination malpractices on the validity of examination has made some examination bodies to give excessive attention to checking examination malpractices even at the test development stage. Over the years, the UTME by JAMB has been in a paper-pencil test (PPT) form, and has been characterized by a lot of fraudulent practices ranging from leakage of examination papers, use of machineries of all sorts by candidates, bribe taking by examination officials, impersonation, use of unauthorized gadgets, and so on (Osuji, 2012).

In order to eliminate or minimize incidence of the vices, and/or other reasons, JAMB in 2013 introduced the computer based testing (CBT) form of UTME and gave massive publicity and sensitization on it. However, the advantages of using computer technology for educational assessment in a global sense have been recognized and these include lower administrative cost, time saving and less demand upon teachers among others. The CBT involved the Use of the mouse, font size, screen clarity, screen size, screen resolution, display rate and scrolling. The User interface-item layout, presentation graphics has been known to affect examinees as they may have difficulty with certain aspects of it, or they may object to particular element of adaptive test delivery.

The challenge on CBT test designers and administrators is to construct CBT to be fair and reliable and to produce valid test scores. More so, they have to be designed to minimize examinees' frustration and to limit the sources of examinee anxiety. This is because student's attitudes and feelings towards a test is an important factor in test design; if it is ignored there may be adverse effect on test outcome. Following these assertions, one would want to determine if Paper-pencil based and Computer based tests would have influence on students' achievement in learning computer studies.

Many students can be assessed at the same time with a Paper-pencil based test, such test is an efficient method of assessment. Paper-pencil based testing is available for traditional classrooms situations, where computer access is limited or where a controlled testing environment is required. For tests that required a written response from examinees (i.e., an open-ended assessment or a performance writing assessment), substantial mode effects were noted (Russell, 1999; Russell & Haney, 2000).

Paper-pencil based tests can be effective when assessing listening and reading comprehension skills. In Paper-pencil based assessments, students provide written responses to written items. Assessments in which you fill out answers on the assessment form itself or electronic form. Typically, Paper-pencil based assessment includes questions to answer, topics to address through paragraph responses, problems to solve and others.

Computer-based test is a modern testing procedure where each examinee answers his/her questions directly on a computer. Computer-based testing requires the examinees to have a basic computer knowledge, which involves appreciation of computer desktop icons, basic mouse use, as well as understanding important navigation. Computer based tests have been since 1960s to test knowledge and problem

solving skills (Peter, 2010). Computer based test assessment has enabled educators and trainers to schedule, deliver and report on surveys, quizzes, tests and examinations (John, 2009). There are two main types of computer based testing modes - a combination of essay examination and practical examination is mostly used for evaluation of students' knowledge. The second type of computer-based testing is where computers provide an assessment interface for students; they input their answers and receive feedback via a computer (Peter, 2010).

Over the years, science educators and researchers in education have intensified their efforts to seek a clearer understanding of the issues involved in the declining interest of secondary school students to computer based test over pencil paper based test. Studies (Busari, 2011; John, 2009) indicate that research efforts have proposed various suggestions and recommendations like evaluation of students' knowledge for improving the quality of teaching and learning in Nigerian classrooms using the computer-based test.

Research has been conducted to evaluate the comparability of computer-based test and paper-pencil based test. Saad (2009) revealed that there was a significant difference between paper-pencil based test and computer based test modes on test scores, while Parshall and Kromrey (2012) reported that there is no significant difference between paper-pencil based test and computer based test modes on test scores. This disparity in the findings of studies comparing paper and pencil test and computer based test shows that further investigation ought to be conducted to critically examine the effectiveness of the two assessment methods especially in subject areas like computer studies where such studies are rare.

In a review of educational measurement approaches, reported studies by Bunderson, Inouye and Olsen (2009) showed that no significant difference existed between Paper-pencil based test and Computer based test. Other studies (Federico, 2010; Watson, 2010) showed a superiority for paper-pencil based test on their findings which was significant. Mead and Drasgow (2012) in a meta-analysis of well-designed computer based test and paper-pencil based test cognitive ability tests also found that on the average, paper-pencil based test scores were very slightly greater than computer-based test scores. Computer based test assessment provide opportunities to measure complex form of knowledge and reasoning that is not possible to engage and assess through paper-pencil based test (Bodmann & Robinson, 2012).

STATEMENT OF THE PROBLEM

Examination malpractice in Nigeria and indeed in many countries of the world is already a cankerworm. The problem has defied most recommended solutions. Examination malpractice has bothered government, educators, researchers, parents and teachers. Research evidence suggested that testing mode today still follow the traditional pattern of testing which is paper-pencil based test. According to these researchers, traditional methods of testing had been identified to contribute to examination malpractice due to the modes of conducting the examination which gives the student chance to cheat in examination hall. Using PPT has been characterized by a lot of

fraudulent practices ranging from leakage of examination papers, use of machineries of all sorts by candidates, bribe taking by examination officials, impersonation, use of unauthorized gadgets, and so on. PPT delays results compared to CBT. All these necessitated the introduction of CBT.

Using CBT, examination malpractice may also be possible like giraffeing, use of phones and so on. But the incidence of impersonation and other malpractice can be reduced when CBT is used. CBT gives instant feedback of assessment thereby giving no room for fraud. The problem with CBT is that students do not know computer. However, CBT may pose a problem for the students in that some of them are not yet computer literate enough to handle CBT. The situation with CBT raises the fundamental question of whether CBT is effective in assessment of students in examinations as compared to PPT. This study therefore, is aimed at finding out the relative effectiveness of paper-pencil based test and computer-based test on secondary students' achievement in computer studies.

OBJECTIVES OF THE STUDY

Specifically, the study sought to investigate:

- ✓ Relative effectiveness of computer-based test (CBT) and paper-pencil based test (PPT) modes on academic achievement of students taught computer.
- ✓ Influence of gender on the achievement of male and female students in computer studies.
- ✓ Interaction effect of assessment mode and gender on the achievement of the students in computer studies.

RESEARCH QUESTIONS

- ✓ What is the difference between the mean achievement of scores of students assessed in computer studies using computer-based test (CBT) and paper-pencil based test (PPT) modes?
- ✓ What is the difference between the achievement of male and female students in computer studies?

HYPOTHESES

- ✓ There is no significant difference between the mean achievement of scores of students assessed in computer studies using computer-based test (CBT) and paper-pencil based test (PPT) modes.
- ✓ There is no significant difference between the achievement scores of male and female students in computer studies.
- ✓ There is no significant interaction effect of assessment mode and gender on the achievement of the students in computer studies.

II. METHOD

This study adopted the quasi-experimental design, specifically, the pretest, posttest, non-equivalent, control group design. The area of the study is Orlu Education Zone in Imo State of Nigeria. There are about 63 government-owned

secondary schools in this zone. The population of this study consists of all the SS2 computer studies students in the 63 government owned secondary schools in Orlu Education Zone 1 of Imo State. The sample of the study consists of 74 SS2 students drawn from two schools out of 57 coeducational secondary schools in Orlu Education Zone 1. The techniques used for selections were Purposive and Simple Random Sampling Techniques. Firstly, purposive sampling was used to select only coeducational secondary schools in Orlu Education Zone 1. Secondly, two schools were chosen using a lucky dip. Thirdly, using a flip of a coin, one of the schools was chosen as the experimental group 1 and the other as experimental group 2.

The instrument for data collection was Computer Achievement Test (CAT). CAT was a 25-item multiple choice questions with four answers options constructed from the topics; input devices, internet, unit of computer storage, and computer programming language. The test mode for experimental group 1 was CBT and was PPT for experimental group 2. The pretest and posttest of the CAT were the same in both content and quality except that the post-test CAT was rearrangement of the item numbers and alternative options in the pretest CAT. The instrument was validated by three experts from Nnamdi Azikiwe University, one from Science Education and two from Educational Foundations Departments for validation. To ensure reliability of the instrument, a sample of 20 SS2 computer studies students from one of the secondary schools in Orlu Education Zone outside the randomly selected schools was administered with CAT. The scripts were collected, marked and analyzed using Kuder Richardson Formular 20 (KR 20) method. Application of KR-20 on the test scores yielded a co-efficient of 0.83.

The researcher visited the schools that were involved to obtain permission from the authorities concerned to use their SS2 students and teachers in the study. The experiment started with briefing of two computer teachers from the schools which were used as research assistants two week before the experiment. Within the two weeks, the researcher visited the research assistants in their schools at an agreed time in order not to disrupt their school activities. The modalities for the treatment and what to emphasize during the treatment were discussed. After the briefing, the research assistants administered pretest to the participants to measure their level of knowledge based on the selected topics. The CAT was given to both experimental 1 and experimental group 2. The researcher supervised the administration of the test with the assistance of the participating teachers to ensure co-operation and similarity of test condition. The research assistants started to teach the students from the selected topics which lasted for four (4) weeks. On fifth week, second test (posttest) was administered to the students in experimental group 1 with CBT and experimental group 2 with PPT with the help of the research assistants and the results was taken and analysed.

In order to reduce participants' interaction, the two schools used were located in the Urban Area to ensure similarity in all characteristics but far away from each other to avoid interaction and communication. To minimize the influence of memory and forgetfulness, the time lag between the pre-test and post-test was four weeks (the treatment period) which is considered to be neither too short nor too

long. The short experimental duration served to control pretest sensitization as well as minimize the effect of maturation. Therefore, Computer Achievement Test (CAT) was used for pretest and was reshuffled and produced on a black and white question paper before used as the posttest.

The administration was done by the researcher with the help of two research assistants and this facilitated easier administration and retrieval of the instruments. The administration lasted for 30 minutes in each of the schools. Thereafter the answer scripts were retrieved and scored. The data were obtained from pretest and posttest was recorded and used for analysis. The statistics used in analysing the research questions is mean while the null hypotheses were tested using Analysis of Covariance (ANCOVA). The decision rule was that where Pvalue was less than 0.05, null hypothesis was rejected, otherwise, the null hypothesis was not rejected.

III. RESULTS

RESEARCH QUESTIONS 1: What is the difference between the mean achievement of scores of students assessed in computer studies using computer-based test (CBT) and paper-pencil based test (PPT) modes?

Assessment Mode	N	Pretest Mean	Posttest Mean	Gain in Mean
CBT	38	24.87	58.11	33.24
PPT	36	26.83	64.33	37.50

Table 1: Mean Pretest and Posttest Achievement Scores of Students assessed using CBT and PPT Modes in Computer Studies

Table 1 shows that the group assessed using CBT had gain in mean achievement score of 33.24, while those assessed using PPT had gain in mean achievement score of 37.50.

RESEARCH QUESTIONS 2: What is the difference between the achievement of male and female students in computer studies?

Assessment Mode	Gender	N	Pretest Mean	Posttest Mean	Gain in Mean
CBT	Male	18	25.39	58.89	33.50
	Female	20	24.40	57.40	33.00
PPT	Male	23	26.96	65.83	38.87
	Female	13	26.62	61.69	35.49

Table 2: Mean Pretest and Posttest Achievement Scores of Male and Female Students assessed using CBT and PPT Modes in Computer Studies

Table 2 shows that the male students assessed using CBT had gain in mean achievement score of 33.50, while the female students assessed using CBT had gain in mean achievement score of 33.00. Male students assessed using PPT had gain in mean achievement score of 38.87, while the female students assessed using PPT had gain in mean achievement score of 35.49.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3950.944 ^a	4	987.736	17.273.000	
Intercept	3405.341	1	3405.341	59.550.000	

Pretest	3070.946	1	3070.946	53.703.000
Assessment	141.499	1	141.499	2.474 .023
Gender	78.244	1	78.244	1.368 .246
Assessment *	49.116	1	49.116	.859 .357
Gender				
Error	3945.705	69	57.184	
Total	284472.000	74		
Corrected Total	7896.649	73		

a. R Squared = .500 (Adjusted R Squared = .471)

Table 3: ANCOVA on Relative Effectiveness of CBT and PPT Modes of Assessment on Academic Achievement of Students in Computer Studies

HYPOTHESIS 1: There is no significant difference between the mean achievement of scores of students assessed in computer studies using computer-based test (CBT) and paper-pencil based test (PPT) modes.

Table 3 shows that at 0.05 level of significance, 1df numerator and 73df denominator, the calculated F is 2.474 with P-value of 0.023 which is less than 0.05. Therefore, the null hypothesis was rejected. Thus, there is significant difference between the mean achievement of scores of students assessed in computer studies using computer-based test (CBT) and paper-pencil based test (PPT) modes.

HYPOTHESIS 2: There is no significant difference between the achievement scores of male and female students in computer studies.

Table 3 also shows that at 0.05 level of significance, 1df numerator and 73df denominator, the calculated F is 1.368 with P-value of 0.246 which is greater than 0.05. Therefore, the null hypothesis was not rejected. Thus, there is no significant difference between the achievement scores of male and female students in computer studies.

HYPOTHESIS 3: There is no significant interaction effect of assessment mode and gender on the achievement of the students in computer studies.

Table 3 further shows that at 0.05 level of significance, 1df numerator and 73df denominator, the calculated F is 0.859 with P-value of 0.357 which is greater than 0.05. Therefore, the null hypothesis was rejected. Thus, there is no significant interaction effect of assessment mode and gender on the achievement of the students in computer studies.

IV. DISCUSSION, CONCLUSION AND RECOMMENDATION

The findings like Choi and Tinkler (2012) has shown that the students taught computer studies using PPT in assessment performed significantly better than those assessed using CBT. The result of this research shows that the students taught computer studies using PPT in assessment performed significantly better in Computer Achievement Test (CAT) than those assessed using CBT. It can be concluded that there is a statistically significant difference between the mean scores of the students on PPT and CBT. Another finding like Boo (1997) has shown that the students taught mathematics using PPT and CBT in assessment. The result of this research shows that the students taught mathematics using CBT in assessment performed significantly better than those using PPT in assessment. It can be concluded that there is a statistically

significant difference between the mean scores of the students on CBT and PPT. In this present study, the students taught computer studies using PPT in assessment performed significantly better than those assessed using CBT. The result of this research shows that the students taught computer studies using PPT in assessment performed significantly better in Computer Achievement Test (CAT) than those assessed using CBT. It can be concluded that there is a statistically significant difference between the mean scores of the students on PPT and CBT.

The findings like Parshall and Kromrey (2012) has shown that there is no significant difference in the performance of male and female students assessed using CBT in assessment. In this present study, the result showed that the male students assessed using CBT had gained mean achievement score of 33.50, while the females had gained mean score of 33.00. CBT equally affected the achievement of male and female students. The slight difference may be as a result of the level of interaction between the males while learning. The findings like Federico (2010) has shown that there is no significant difference in the performance of male and female students assessed using PPT in assessment.

V. CONCLUSION

The result showed that the male students assessed using PPT had gain in mean achievement score of 38.87, while the female students assessed using PPT had gain in mean score of 35.49. PPT equally affected the achievement of male and female students. The study therefore, establishes that there is a significant difference between students' assessed using paper-pencil based test (PPT) and computer based test (CBT) in favour of those assessed using PPT and that gender has no significant influence on the achievement of students despite the assessment mode.

VI. RECOMMENDATIONS

Based on the finding and conclusion of the study, the following recommendations were made:

- ✓ The students should be allowed to be acquainted with CBT. More training is needed before nay school would introduced it as the only test mode.
- ✓ Government should make ICT training compulsory for secondary schools' teachers and students to get them to become more competent in CBT examinations.
- ✓ Government policy on ICTs should be fully implemented giving attention to teachers and students with little or no knowledge of computer and CBT examination.

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