E-ISSN: 1115 - 8425 P-ISSN: 3027-012X
MPRI-JAEE | INTERNATIONAL JOURNAL OF ASSESSMENT & EVALUATION IN EDU.
VOL. 12 NO. 8 – APRIL. 2026

EFFECTS OF TESTING MODE AND COMPUTER FAMILIARITY ON FIRST-YEAR STUDENTS' ACHIEVEMENT IN CELL BIOLOGY AT FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

IDRIS, UMAR SARKINBAUCHI (Ph.D.)[1]; HARUNA, RAHMATU (Ph.D.)[2]; HAMMAN, MATHEW JOSEPH (Ph.D.)[3]; & EZEAMAGU, MARY[4]

[1]Department of Science Education, Federal University of Technology, Minna, Niger State, Nigeria. [2]Department of Science Education, Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria. [3]Directorate of Innovation, Research and Development, Nigerian Army University Biu, Borno State, Nigeria. [4]Department of Educational Foundations, Faculty of Education, Sokoto State University, Sokoto, Nigeria

Corresponding Author: haumar2008@gmail.com1

DOI: https://doi.org/10.70382/mejaee.v12i8.0124

Abstract

Computer-Based Test (CBT) has become a central concern in educational assessment not only in Nigeria, but in almost all countries of the world. Governments, examination bodies, institutions and organizations have accorded CBT much priority as a result of the potentials manifested by the mode over the years, ranging from accuracy, speed, objectivity and innovation. Numerous studies were embarked upon as to unfold the validity evidences necessary for the smooth transition from the traditional Paper-Pencil- Test (PPT) to the CBT in educational assessment with varied and inconsistent results. This paper reports a study conducted on the effects of testing mode and computer familiarity on first-year students' achievement in Cell Biology at Federal University of Technology Minna, Niger State. Repeated measures design was adopted using first year university students. Purposive sampling

Keywords: Computer-Based Test, Paper-Pencil Test, Cell Biology, Assessment, Testing Mode, Computer Familiarity.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

technique was employed in getting the university course and the sample of the study (1130 participants). The research instruments were Cell Biology Achievement Test (CBAT) and Computer Familiarity Scale (CFS) which were validated by five experts. Reliability coefficient of CBAT using KR20 was .78 and CFS yielded .79 using Cronbach Alpha formula. The parallel form reliability coefficient of .91 for the CBAT modes (CBT and PPT) was obtained using Pearson Product Moment Correlation (PPMC). Data generated was analyzed using One-Way Repeated Measures ANOVA and independent t-test accordingly. Findings revealed that there was significant difference between the academic achievement of first year students in Cell Biology CBT and PPT modes ($F(1, 1129) = 2380.943$, $P < 0.05$). The findings also discovered that there was significant difference between the academic achievement of less and more computer familiarity first- year students in Cell Biology CBT mode, $t(1128) = 3.840$, $P < 0.05$. It was recommended among others that schools and departments should be well equipped with computer facilities to enhance computer skills capable of averting any irrelevant variance in the academic achievement of students in Biology electronic assessments.

Introduction

Tremendous developments in science and technology over centuries could be attributed to the long term investment in science and technology education across the world. The attainment of any national development goals is only feasible when much attention is accorded education in any given society. Several countries, including Nigeria, planned and developed curricula as to attain the set national development goals translated in to educational objectives which were put in to implementation in learning institutions over the years. To have feedback of any effective curriculum implementation, results from effective testing in the classroom instruction are inevitable (Adekunle, *et al*., 2018). Thus, testing can be said to be the bedrock of curriculum implementation which in turn serves as feedback to curriculum development, planning and above all, culminating to the achievement of national development goals of all nations.

In present days, computers have become more of a medium of testing of students' academic performance across the world, especially in the developed countries such as United States of America (USA), England, China, Australia and many more but African countries like Nigeria are new in the transformation. Mode of testing in learning institutions in Nigeria mostly remained the traditional Paper and Pencil Test (PPT) for more than a century. Until few years back when the e-testing began to surface through tertiary institutions. In Nigeria, for example, the National Open University of Nigeria (NOUN) pioneered this innovative testing in 2002, followed by several universities and

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

other tertiary institutions across the nation. Some examination bodies like Joint Admission and Matriculation Board (JAMB) and National Examinations Council (NECO) also adopted the innovation which is more prominent from 2023 to 2026.

Assessments and record keeping in our society have been bewildered by inconsistency, delay, errors and other setbacks that threatened the quality of assessment and general data generation. With the proliferation of computers and other digital facilities, most of those challenges are fast becoming a thing of the past. This is possible as a result of the advantages of computers which include accuracy, speed, simplicity and objectivity and scaling or wide coverage that the traditional paper assessment lacked. The most important psychometric potentials of any assessment is the extent to which the scores are valid. A test must truly assess the target constructs it was developed for. This of course necessitates mode effects studies in educational assessment. Mode effect is the negative or positive impacts a mode of testing has on the academic achievement of learners (Adaramaja & Victor, 2022). As an innovation in educational assessment, there is every need to study the validity of CBT as to avert any negative impact it could have to the quality of educational assessment across the learning institutions.

Statement of the Problem

The integration of ICT in to teaching and learning in has been fast influencing the modern day education across the globe. Several learning institutions, examination bodies and organizations in Nigeria have followed the trend since 2008 to 2026. Most prominent include NECO, JAMB and many universities such as Federal University of Technology Minna (FUT Minna), University of Ilorin, University of Ibadan and many more It was observed that many fresh students of the university perceived CBT as a difficult mode of testing, showing dislike and nervousness whenever they are prompted with CBT, and happier during traditional PPTs. Another significant factor that is worthy to be considered in implementing CBT in Nigerian learning institutions is the dwindling nature of ICT facilities which include inadequate computers, poor internet and electricity (Abdullahi & Lawan, 2025, Okeke, 2025) which hinder computer familiarity and competence among students which is vital in writing CBTs. In addition, occasionally, high performing students are often found to be failing CBT courses more, compared to PPT courses, signifying possible causes such as low computer familiarity, computer anxiety and other technical factors. To this end, many empirical studies revealed inconsistent results on the equivalence of CBT and PPT (Nebert, 2024), with limited studies in Nigeria as a nation experiencing rapid shift from analogue to digital assessment. Hence the authors dived in to this study as to discover the possible mode and computer familiarity effects on students' performance in Cell Biology among first year students in FUT Minna, Nigeria.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Aim and Objectives of the Study

The aim of the study was to determine the students' differential performance in cell biology based on mode of testing and level of computer familiarity in Minna Niger state, Nigeria. The objectives were to:

i. determine the difference in first year students' academic performance in CBT and PPT Cell Biology in FUT Minna
ii. determine the difference in first year students' academic performance in Cell Biology based on to the level of computer familiarity in FUT Minna.

Research Questions

The following research questions were raised to achieve the stated objectives:

i. What is the difference in first year students' academic performance in CBT and PPT Cell Biology in FUT Minna?
ii. What is the difference in first year students' academic performance in Cell Biology based on to the level of computer familiarity in FUT Minna?

Research Hypothesis

The following null hypotheses were formulated ant tested at 0.05 to answer the research questions:

H_o1: There is no significant difference between the mean performance scores of first year students in Cell Biology CBT and PPT in FUT Minna?

H_o2: There is no significant difference between the mean performance scores of first year students in Cell Biology CBT based on to the level of computer familiarity in FUT Minna?

Literature Review

The integration of computers in teaching and learning among learning institutions across the globe have become a long-term practice. More recently, computers are being used in administration and scoring of tests and examinations in developed and developing world, Nigeria inclusive. This innovative assessment technique can be effectively implemented only in societies with adequate Information and Communication Technology (ICT) facilities. To use computers in assessment, students are expected to possess some computer basic skills or competence as to be able to tackle any assessment task with ease. This can only be achieved if students or test takers are exposed to computer facilities on daily basis as to improve their level of computer experience and familiarity.

The two modes of testing widely used in educational settings are the Paper-Pencil Test (PPT) and more recently Computer-Based Test (CBT). The oldest mode of testing is the PPT, which is the type of testing in which testees respond to test items on papers using their pens and pencils (IGI Global Scientific Publishing, 2024). It is also referred to as

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

traditional assessment formats in which testees read questions and write their responses or simply use pencil to fill in bubbles on a scannable answer sheet (Teachers Institute, 2025). CBT is a mode of testing in which students respond to test items on computers and are scored by computers (Synap, 2025). In educational assessment, if a mode of test explains variance in the scores derived from testing, the validity of such test scores is inconclusive.

Mode of Testing Effects on Academic Performance

Over three decades, there have been rigorous studies on the equivalence of CBT and PPT scores with inconsistent findings. Some studies revealed that CBT has more advantage to students' performance, while others revealed no difference between the two modes. For example, Adeneji and Ubolum (2016) conducted a study and compared the mean performance scores of secondary school students in General Mathematics with different modes of testing with 72 SS3 students of Deeper Life High School, Port Harcourt. It was consequently found that there was no significant difference in the students' performance based on the two modes of testing. Adaramaja and Victor (2022) studied effects of mode of testing using CBT and PPT in 200 level educational research course. The findings indicated that students did better in CBT than PPT. In another study by Jack and Sam (2020), students from urban and rural areas were subjected to CBT in which the finding revealed a significant difference in the performance the two groups in favour of the urban students. Nalbantoglu (2021) meta-analyzed 37 CBT and PPT comparative studies, in which based on the overall effect size, it was discovered that the two modes were equivalent. Furthermore, Scrimgeour and Huang (2022) studied State Biology CBT and PPT end-of-course examination. The results revealed a significant mode effect on the performance of the students. From the results, it appeared that students' performance in PPT was far better than that in CBT. In another related study,

From the previous discussion, it can be deduced that there was fluctuation in the academic performance among students based on the mode of testing and subject matter. This signifies the need to expand the research on this dimension as to have in-depth understanding of the factors responsible for the differential performance as to smoothen the transition to the e-assessment in the country.

Effects of Computer Familiarity on Academic Performance

Nigeria is one of those countries battling with low ICT compliance as a result of inadequate computers and other relevant technologies in learning institutions. Researchers surveyed the level of ICT compliance across several learning institutions in Nigeria, with revelation that indicates inadequate provision of such facilities in schools and tertiary institutions. Many schools in Nigeria lack computers and other ICT necessities (Olowu, 2025).

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

According to a report by United nations Educational, Scientific and cultural organization (UNESCO) as explained by Okeke (2026), in Nigeria, out of 320 technical and vocational intuitions, less than 10 percent possess adequate internet access, and less than 25 percent have capacity for digital training and more than 50 percent lack electricity. This report does not cover other secondary schools and tertiary institutions, which from all indications, other reports have similar conditions. For example, it was revealed that in colleges of education in North-West Nigeria, 84% havr poor internet connectivity, and 69.2% have inadequate ICT facilities (Ado & Nura, 2025). This development is capable of hindering smooth transition from PPT to CBT across the schools in the state. Students that emerge from rural environment, where the computer facilities are drastically inadequate will tend to perform poorer than those in the urban environment that have more of the computer facilities. This is because, level of computer experience differs as a result of differential exposure to the facilities. Thus, giving same CBT tasks to the students from the two backgrounds will seem to be unjust, and can lead to having construct irrelevant variance in the scores to be generated, which a threat to internal validity of the whole assessment. In Nigeria today, students from urban and rural areas are tested in Unified Tertiary Matriculation Examination (UTME) and other high stake examinations using CBT. Consideration is not given to the individual differences in computer familiarity which can threaten the validity of the assessment. This is possible if the testees develops anxiety during the testing activities, or find it difficult to access digital items on a computer as a result of poor computer experience.

As a recent construct in e-assessment, computer familiarity was also studied by some researchers, despite the fact that it is obvious that this dimension of research was not widely studied especially in Nigeria. Vast number of studies on computer familiarity focused on how it affects variables such as attitudes towards computers and technology, self-efficacy, perception and others. Computer literacy is still challenge in a Nigeria which could serve as a barrier to the effective implementation of CBT in educational assessment. Oshin and Badmus (2020) examined the familiarity, utilization and effective use of ICT in classroom instruction and were able to discover that educators in Nigeria had low level of computer familiarity and utilization which consequently jeopardizes adequate preparation of students for present and future computer tasks in academics. Another study reported similar findings among fresh students at the University of Rwanda which revealed that the majority of students are not familiar with technology and never had any previous exposure to eLearning systems (Jean *et al.* (2018).

Several studies were conducted on the effect of computer familiarity on academic achievement of learners at different levels of education. Although there is limitation of empirical evidence on this dimension. For example, Shehu *et al.*(2025) investigated the impacts of digital literacy and test anxiety on students' performance in CBT STEM

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

examination. Findings revealed no significant effect of digital literacy on students' performance. In another study, Abdulkareem and Lennon (2025) investigated the impact of digital skills on students' performance in CBT Unified Tertiary Matriculation Examinations (UTME) and the results revealed that students' prior computer experience significantly impacted their performance. Emmanuel, et.al. (2025) investigated impact of ICT preparedness on performance in CBT, which indicated a significant impact.

Methodology

Research Design: The study adopted repeated measures design. The repeated measures design is a powerful design with the ability of detecting small within group mean difference in performance (Minitab,2019) The students were tested first using CBT and after period of two weeks PPT was administered.

Population of the Study:

The population comprised all 5,184 first-year science students in FUT Minna, Niger State, 2019/2020 session. The target population was 1130 first-year students enrolled in a central 100 level course, Cell Biology. This a core course at this level without which students can never graduate.

Sample and Sampling Techniques:

Purposive Sampling technique was adopted at different stages. In the first place, purposeful sampling was used in the selection of the university in the municipal which have enough facilities to usher the experiment compared to the affiliated ones in the area. First year students where the target population as the university mandated their assessment to be CBT across the courses and are not much exposed to computer tasks. The Cell Biology was selected based on the fact that it is a central course offered by all science students at the first year in the university. The samples made up of 1130 students enrolled in the course

Research Instruments: The instruments used in data generation for this study were Cell Biology Test (CBAT) parallel forms in CBT and PPT, containing 60 multiple choice items and Computer familiarity Scale (CFS) with 25 items. Cell Biology Test items were derived from the contents of the course which include principles of ecology, eco-system and the concept of the biosphere; interrelationship between biotic and abiotic factors; energy flow: nutrient cycles in ecosystems, ecology of communities; tropical terrestrial and aquatic biomes and ecological succession and adaptations. For the CFS, 25 items were derived from four dimensions, namely, use of computer applications, basic computer operation skills, knowledge of computer basic concepts and factors affecting computer use.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Validity of the Research Instrument:

The CBAT (CBT and PPT) and CFS were given to five experts in science education and educational research, measurement and evaluation. The experts adjudged the two instruments valid after necessary corrections were made. Content validity Ratio (CVR) was calculated and perfect score 1.00 was obtained which is the bench mark coefficient for five validators.

Reliability of the Research Instruments:

The two instruments were pilot tested with 50 students within the population. The data generated were tested for reliability. The reliability coefficient of the CBAT was established using KR20, which yielded .78 and CFS yielded .79 using Cronbach Alpha formula. As the motive of the study was to compare the two modes of testing, two parallel form CBAT (CBT and PPT) were pilot tested. The parallel form reliability coefficient of .91 was obtained using Pearson Product Moment Correlation (PPMC) formula. The motive was to ensure that the two modes of test were equivalent before administration. All the coefficients obtained indicated that the instruments were reliable.

Method of Data Collection:

The participants of the study were fully informed of the objectives of the study and their consent was sought for. Permission to gain access to the participants and facilities was obtained through normal protocol of the university. The participants studied the course under normal and equal condition to the period of testing. The researchers with the aid of the research assistants, administering the two modes of test in a counter-balanced method. Some students sat for the CBT first, while others sat for the PPT. Computer familiarity scale was administered prior to the CBAT. After two weeks, same procedure was repeated alternating the two modes of test. Eventually all participants had records of performance in CBT and PPT cell Biology which were coded for analysis.

Data Analysis Techniques:

Descriptive statistics – mean and standard deviation were used to analyze the demographic data of the respondents alongside their achievement profiles. One-Way Repeated Measures Analysis of Variance (ANOVA) was used in testing hypotheses one while. Independent t-test was employed to answer the hypothesis two. Repeated measures ANOVA is a statistics equivalent to independent ANOVA that is used for analysis of variance of the related groups that are not independent. Statistical package for Social Science (SPSS) version 23 was used in the analysis.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Results

Table 1: Sample Distribution Based on Gender

Gender	Frequency	Percentage
Male	553	48.9
Female	577	51.1
Total	1130	100.0

Table 1 describes the sampling distribution of the students in this study. From the table, there was 1,130 first year students who participated in the experiment. There was 553 male students constituting 48.9 percent of the students, and 577 female students constituting 51.1 percent of the total number of the students. All the students undergone repeated measurements using CBT and PPT in the study.

Research Question One: What is the difference in the academic achievement of first year students in BIO121 CBT and PPT modes of testing in F.U.T. Minna?

Table 2: Mean and Standard deviation of the Difference in the Academic Achievement of First Year Students in Cell Biology CBT and PPT in F.U.T. Minna

Testing Mode	N	Mean	SD	Mean Difference
Compute-Based test	1130	26.19	7.13	5.11
Paper-Pencil-Test	1130	31.30	6.20	.

Table 2 presents the mean and standard deviation of the difference in the academic performance of first year student in Cell Biology CBT and PPT in F.U.T. Minna. From the results, the students had means score of 26.19, standard deviation of 7.13 in the CBT. In the PPT, the students obtained mean performance score of 31.30, with standard deviation of 6.20. The mean difference between the two modes was 5.11, which signifies that there was difference in the performance mean scores of first year students in Cell biology CBT and PPT in F.U.T. Minna.

Research Question Two: What is the difference in the level of computer familiarity of 100-level students' in F.U.T. Minna?

Table 3: mean and Standard deviation of the Difference in the Level of Computer Familiarity of First Year Students in F.U.T. Minna

	Computer Familiarity Levels	N	Df	Mean	SD	Mean Difference
Computer-Based Test	Less Comp. Familiar	213	1128	24.51	7.126	2.07
	More Comp. Familiar	917		26.58	7.074	.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Results in Table 3 showed the levels of computer familiarity of the 100 Level students in Federal University of Technology Minna (F. U. T.). It showed that 213 students (18.85%) were less computer familiar and 917 students (81.15%) were more computer familiar. Which indicates that the majority of the students were more computer familiar. This implies that there was difference in the level of computer familiarity among first year BIO121 students in F.U.T.M.

Hypothesis Testing

H_o1: There is no significant difference between the mean performance scores of first year students in Cell Biology CBT and PPT in FUT Minna

Table 4: One-Way Repeated Measures ANOVA Results of the Difference in Cell Biology CBT and PPT Academic Achievement of 100 level Students in F.U.T. Minna

	Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Achievement	Sphericity Assumed	739405.248	1	739405.248	2380.943	.000*	.678
	Greenhouse-Geisser	739405.248	1.000	739405.248	2380.943	.000	.678
	Huynh-Feldt	739405.248	1.000	739405.248	2380.943	.000	.678
	Lower-bound	739405.248	1.000	739405.248	2380.943	.000	.678
Error(Achievement)		350612.502	1129	310.551			

***= Significant at 0.05**

The Mauchly's Test of Sphericity which is a pre-requisite in the repeated measures ANOVA revealed a perfect Epsilon test because of the fact that there were only two repeated measurements in the experiment in which variances of the differences were assumed to be equal. Results. In table 4 explains One-Way Repeated Measures ANOVA of the difference in the students' achievement in Cell Biology CBT and PPT modes. Provided the Sphericity was assumed, F (1, 1129) = 2380.943, $P < 0.05$. Hence the null hypothesis was rejected, this implies that there was significant difference between the mean achievement of first-year Students in Cell Biology CBT and PPT modes in F.U.T. Minna. The effect size was found to be .68, which was a strong effect size.

H_o2: There is no significant difference between the mean performance scores of first year students in Cell Biology CBT based on to the level of computer familiarity in FUT Minna.

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Table 5: t-Test Results of the Difference between Less and More Computer Familiar of First-Year Students' Mean Achievementcores in Cell Biology CBT in F.U.T. Minna

	Computer Familiarity Levels	N	Df	Mean	SD	T	p
Computer-Based Test	Less Comp. Familiar	213	1128	24.51	7.126	3.840	.000*
	More Comp. Familiar	917		26.58	7.074	.	

*= Significant at 0.05

Results in Table 5 showed the t-test results of the difference between the mean achievement scores of less and more computer familiar of first-year students in Cell Biology (CBT) in F.U.T. Minna. It is evident from the results that the less computer familiar students had mean score 24.51, standard deviation 7,13, while the more computer familiar students had mean score 26.58, standard deviation 7.07. The t (1128) = 3.840, P < 0.05, therefore, the null hypothesis was rejected. It revealed that there was significant difference between mean achievement scores of less and more computer familiar of first-year students in Cell Biology (CBT) in F.U.T. Minna

Discussion of Results

The study investigated the effects of mode of testing and computer familiarity on students' achievement in Cell Biology in FUT Minna. The findings of the study established that there was significant difference in the achievement of first year student in CBT and PPT Cell Biology in FUT Minna. This is in line with Adeneji and Ubolum (2016) who compared the mean performance scores in Mathematics of secondary school students in Paper-Pencil Tested (PPT), Dual-Based Test and Computer-Based Test and discovered no significant difference based on the modes. The finding also supports the study of. Adaramaja and Victor (2022) on the effects of mode of testing using CBT and PPT in 200 level educational research course. The researcher then discovered that students scored better in CBT than PPT. Another supportive evidence on this finding is the work of Scrimgeour and Huang (2022) studied state Biology CBT and PPT end-of-course examination and found a significant mode effect on the performance of the students. From the results, it appeared that students' performance in PPT was far better than that in CBT. Parallel to the finding of the study, is the finding of Nalbantoglu (2021) who meta-analyzed 37 CBT and PPT comparative studies and found out that no significant differences was reported in the majority of the empirical studies. The finding also deviates from that of. Shehu *et al.* (2025) who discovered an insignificant performance difference between CBT and PPT Biology contents assessed. In addition, the finding was not in

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

agreement with that of Wassenberg, *et al.* (2022) who found in an introductory Biology class that students had equal performance CBT and PPT regardless of subgroups among the participants.

The difference in the performance of students in the two modes might be feared to be caused by practice effect as a result of writing the modes of testing in two weeks interval. This fear could have been mitigated by the design as counter-balance method was used during the experiment. This could have controlled the practice effect on the variance of the distribution. Furthermore, repeated measures design has basic assumption of Sphericity which in this study was not violated in this study.

The findings also revealed that there was significant difference between the academic achievement mean scores in Cell Biology of more and less computer familiarity students in FUT Minna. This is in line with the findings of Abdulkareem and Lennon (2025) investigated the impact of digital skills on students' performance in CBT UTME and the results revealed that students' prior computer experience significantly impacted their performance. The finding corroborates that of Emmanuel, *et.al.* (2025) whose finding indicated that ICT preparedness had impact on students' performance in CBT. The findings on the other end, disagreed with the findings of Shehu *et al*. (2025) in their study on the effect of digital literacy and test anxiety on students' performance in CBT STEM examination., and the results revealed that there was no significant effect of digital literacy on students' performance in Biology. The findings furthermore, was parallel to the findings of Kevogo (2025) on the effect of general use of computer on students' performance in Biology and the results revealed that no relationship was found between the two constructs.

From the previous discussion, it is obvious that CBT and PPT modes alongside computer familiarity have been found to have impact on academic achievement in several studies including the present study, but found to have no effect in several studies reported. It can be deduced from these inconsistent findings that mode effect could be racial, environmental and population based, as these reports covered several places and races of the world.

Conclusion

Based on the findings of the study, the authors conclude that CBT and PPT are not always equivalent as mode effect was evident in the students' performance in Cell Biology in the two modes. In addition, prior computer knowledge and experience have significant effect on students' performance in Cell Biology. Interpretation of scores derived from CBT has to be done with caution as a result of internal validity evidence surrounding the mode of testing until all threats are controlled.

Recommendations

The following recommendations were given based on the findings of the study:

1. Test scores derived from CBT should be treated with caution especially in areas with low level of computer literacy and accessibility.
2. Learning institutions should be equipped with adequate computer facilities as to enhance computer familiarity and competence among students.
3. Level of computer familiarity be assessed among students to be examined using CBT as to avoid irrelevant variance in the measurement.
4. CBT tutorial centres be established by the university as to improve access to computers among Students, especially the new or first year students.
5. Students should always be exposed to CBT mock tests and examination as to improve computer familiarity and remove anxiety among them.

Limitations of the Study

The following are the limitations of this study:

1. The study only considered first year students of FUT Minna which narrow the generalization of the study to other levels of the student.
2. Practice effect was not fully accounted for, but was assumed to be taken care of by counter balancing of the testing activity and sphericity of distribution achieved.
3. Only one of the general courses in science was tested.

References

Abdulkareem, Z & Lennon, M. (2025). Impact of Digital Divide on Students' Performance in Computerized UTME in Nigeria. Information Development, 41(4), 1265-1280. https://doi.org/10.1177/02666669231191734

Adaramaja, L. S. & Victor, O.E. (2022). Comparability of Computer-Based and Paper-And-Pencil Tests on Students' Performance in Educational Assessment Course at Federal University Gusau, Nigeria. *Journal of Educational Research in developing Areas*,3(2),114-126. Doi:10.47434/JEREDA.3.22022.114

Adekunle, T. O.; Rafiu, A.O. & Awolabi, H. O. (2018). Predictive Validity of Students final continuous Assessment Scores in Mathematics and Biology Using Their performance in National Examinations Council as a Criterion Measure. *FUDMA Journal of Educational Foundations*,1(1),148-158.

Adeneji, K. J. & Ubulom, W.J. (2016). Comparative Analysis of Senior Secondary School Students' Academic Performance in General Mathematics using Different Testing Modes. International *Journal of Innovative Information Systems & Technology Research* 4(2):24-28. https://www.seahipaj.org.

Abdullahi, A. M. & Lawan, N. M (2025). Factors Affecting Service Delivery in e-libraries of the Colleges of Education in Northwest Nigeria. Information Technologist, 22(1), 256-265. https://www.ajol.info/index.php/ict/article/viw/299506

Federal University of Technology Minna (2020). Students Data. ITS Office, FUT Minna.

IGI global Scientific Publishing (2024).m Paper-Pencil Tests. IGI Global Dictionary of Information and science and Teaching. https://www.igi-global.com/dictionary-assessment-young-language-learners/96775

Jack, G. U. & Sam, K. D. (2020). Gender Differences of Senior Secondary School Students' Academic Achievement in Biology Using Computer-Based Test and Paper-Based Test. *Journal of Educational Development and Assessment (JEDA)*, 27(2), 208-221. https://journals.journalsplace.org/index.php/JEDA/article/view/212

EDITOR-IN-CHIEF
Prof. A.I. Mteiye [MALAWI]

Jean, C. B., Henrik H.; Mugabe M. and Ben, R. (2018). Familiarity with Technology Among First-Year Students in Rwandan Tertiary Education. The Electronic Journal of e-Learning, 16 (1), 30-45. https://www.ejel.org.

Minitab (2019). Repeated Measures Design: Benefits, Challenges and an ANOVA Example. https://blog.minitab.com

Nalbantoglu Yilmaz, F. (2021). Comparing Paper-pencil and computer-based Tests: A Meta-Analysis of study in the Sample of Turkey. *Eurasian Journal of Educational Research*, 1(93), 279-300. Doi:10.14689/ejer.2021.93.13

Nebert, K. (2024). Effect of Computer-Based Instruction on secondary School Learners Academic Achievement in Biology. *African Journal of Education and Practices*, 10(1), 1-22.

Okeke, C. (2025, February, 11). Only 10% of Technical Colleges have Internet, 58 Students Share One Teacher. New Telegraph. https://newtelegraphng.com/only-10-of-technical-colleges-have-internet-58-students-share-one-teacher-report

Olowu, G. (2025, September 26). Why Nigeria's curriculum needs More Than Content. The Punch. https://punchng.com/why-nigerias-curriculum-needs-more-than-content/

Shehu, A., Ahmed, R. A., Abdulrahim, B. J., Bello, Z. A., Olarenwaju, B.Y., Ibrahim, I. I. B., Yahaya, Q., Salawu, S. A., Atotileto, Z.B. & Adeniyi, G.I. (2025). Digital Literacy, Test anxiety in STEM Examination: A Comparative Study of Computer-Based Assessment. *FNAS Journal of Measurement and Science Education*.7 (2), 62-71. https://doi.org/10.63561/fnas-jmse.v712.1091

Scrimgeour, M. B. & Huang, H. H. (2022). A Comparison of paper-Based and Computer-Based Formats of Assessing students' Achievement. *Mid-Western Educational Research,* 34(1)69-92.

Sulyman, R. (2025). Comparative Analysis of measurement Precision in CBT and PPT Using IRT Among Undergraduates in Kwara state. *Ilorin Journal of Education*,46(2), 79-89. https://ilorinjournalofeducation.com

Synap (2025). Computer-Based Testing. In Exam Terminology Glossary: 50 + Key Terms Explained. https://synap.ac/blog/exam-terminology-glossary/#c

Teachers Institute (2025). *Understanding Paper-Pencil-Test in educational Assessments*. SAGE Encyclopedia of Educational Research. https://teachers.institute/assessment-for-learning/paper-pencil-tests-educational-assessment

Wassenberg, D. M., Walker, J. D., Binkowski, K. & Peterson, E. (2022). First Do No Harm: In-Class Computer-Based Exams Do Not Disadvantage Students. *Journal of College Science Teaching,* 51, (6), 45-55. https://doi.1-.1080/0047231.2022.12315649