

Perception of the Implementation of Computer-Based and Computer Adaptive Testing in Science Subjects among Senior Secondary Schools in Bwari Local Government Area, Abuja

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DOI: <https://doi.org/10.47772/IJRISS.2026.10200487>

Received: 23 February 2026; Accepted: 28 February 2026; Published: 17 March 2026

ABSTRACT

The study assessed the perceptions of teachers and students regarding the feasibility of the implementation of computer-based and computer-adaptive testing in science subjects among senior secondary schools in the Bwari Area Council, Abuja. A descriptive survey research design was adopted for the study. The study population consisted of 5,804 secondary science students and 96 science teachers from secondary schools in the Bwari Area Council. A simple random sampling technique was used for selecting schools for the study, while a sample of 374 students and 66 teachers was used for the study. An instrument titled “Computer-Based and Computer Adaptive Testing for Science Subjects in Secondary Schools in Abuja Questionnaire (CBCATSSSSAQ)” was used for data collection. The questionnaire was validated by three experts in the Faculty of Science Education, Veritas University Abuja. A trial test was conducted on 30 students and 30 teachers who were not part of the sample but part of the population, using Cronbach's alpha reliability the trial test yielded a result of 0.92. The collected data were analyzed using mean and standard deviation to answer the two (2) research questions, while the hypothesis was tested using a t-test at a 0.05 significance level. The study found out that there are many challenges facing the actual feasibility of the implementation of CBT and CAT such as inadequate access to computers and technological resources to conduct CBT and CAT effectively, insufficient internet connectivity to support CBT and CAT sessions among others. Based on these findings, it was recommended that the government and relevant stakeholders should initiate targeted investments in digital infrastructure and pilot CBT and CAT programmes in secondary schools in Bwari Area Council, and school principals should ensure that internet facilities are provided in their schools to facilitate CBT and CAT and improve students' engagement.

Key words: Technology for assessment, Computer based testing, Computer adaptive testing, science subjects.

INTRODUCTION

The rapid development in the world today has made it imperative to treat education as an urgent aspect of the national development than need total overhauling of the produces from its system. Students should be trained to meet up with global trends so that they can be employable, and live out their full potentials.

Education should provide the requisite skills for both the marginalized, and disabled in the society, to live out their full potentials and this should be seen as a lifelong affair. (UNESCO,2022). In-order to achieve this great fit, the integration of ICT to teach and assess students effectively cannot be overemphasized (Eniayeye, & Iyawe, 2019). Secondly, the role of science education is seen as a tool that can be used for societal development that can benefit every strata of the nation's development. (Baroody, 2017; Kpodoe et al, 2023; Dontoh et al, 2023). The educational system must be totally overhauled to ensure a drastic change in the way things are done: - Teaching, learning, and the way assessment is carried out within the educational system. Recently, the Government of Nigeria, is encouraging teachers to put in more efforts in the way science subjects are been taught and assessed in schools across the Nation (Federal Republic of Nigeria, 2014). There is no

doubt of the tremendous impacts Science Education has on the Nation's development, we have witnessed great technological advancements as a result of the knowledge gained from studying the sciences. Ezugwu, Dadzie and Ocheni (2024) noted that due to the crucial roles of science education in Nation development, basic science was introduced into the Nigeria primary school, starting from the basic science, also the Secondary schools were not left behind, science subjects were also introduced in secondary schools for students who intend to build a career in science related field of study, such as the health sciences, engineering, technology, physical and applied sciences. The subjects are Physics, Biology, Chemistry, Computer Science, and Mathematics, successfully passing these subjects in Credit scores in external examinations (WAEC, NECO, UTME, etc.) is a prerequisite to gaining admission into the University, hence the assessment of these subjects shouldn't be taken lightly. Engaging, and introducing the use of computer for assessment is a helpful way of improving the assessment of these subjects. Most developed countries now use computers to improve the accuracy and efficiency of the evaluation process, this has made it easier for educators to assess students' learning and track their progress. The paper and pencil test has several shortcomings and requiring some much resource especially human resources, but computers can help bridge the gap as it has the capability to produce better and efficient results. (Conole & Warburton, 2016)

According to Bull and McKenna (2004) defined computer in assessment as "the use of computers for assessing student learning". Computer-based assessment involves a computer program, marking answers that were entered directly into a computer." Conole & Warburton, (2004) stated that "Computer-based technology has revolutionized the evaluation of student tests by offering various advantages such as automated grading, instant feedback, increased test security, increased accessibility, and convenience for the students', and data analysis to track students' performance over time." Due to the numerous benefits of computers for assessment, several universities and educational bodies have embraced the use of computers as technology for assessment especially when dealing with a large pool of students. The major technology employed is computer-based testing, while computer Adaptive test is gradually being introduced in schools.

Computer based test engage computers to conduct a test or an examination. CBT is the use of computer to assess students instead of the traditional method of testing. Some of the test can be online or off-line. There are several benefits we can get from introducing CBT in our classrooms, these includes innovative assessment practice, ensuring effective testing, and instant feedback. Due to technological advancements, there are various versions of the technology such as the use of Google Forms to assess students. This may not necessarily use a computer but a phone or internet enabled tablet.

In CAT, computer select items from item bank according to their indices level (difficulty or easiness level), easier items are presented to students first and as they answer, an item with a slightly higher indices (difficulty level) is presented next, the students continues to answer the items as they are presented, while the computer ensures to select items that matches with students current ability level. The test is concluded when the student's keeps failing different items presented at varying indices, when this happens, the test stop. The computer immediately notes the level the student's couldn't pass anymore. This type of testing procedure is called tailored testing, as the test is seen as custom made to determine each examinee's ability. From the foregoing, it is paramount to incorporate the use of technology such as CBT and CAT as an important tool to help the way tests are conducted within the educational system. The west Africa examination body (WAEC) and Universities Tertiary Matriculation Examination (UTME) has embraced the computer based assessment, also in several universities were they have large population for certain courses like the General studies examination (GSTs) make use of CBT for convenient purposes, which is a great development compared to the usual delays in conducting such exams especially delays in results coalition, other issues that arise such as missing scripts and test insecurity. Below are some of the benefits of the use CBT and CAT in an Educational system.

- a. Improve test items security: Research has shown that CAT and CBT has enhanced test security, as it minimizes contact to human hands, from questions sorting, transportation and administration, CBT and CAT has been very efficient in preventing examination questions leakages as compared to the traditional testing method.
- b. Secure test environment: there have been cases of examination malpractice like testees impersonation in test centres. The use of CBT and CAT, can help reduce challenges related to such, as the system has several layers of standard Identification for test takers before they can gain access to write their examination.

- c. Reliability of test score: the use of CBT and CAT in monitored environment can enhance the reliability of the test scores as all interferences has been handled.
- d. Advanced test administration: test administration is easier and more efficient with use of technology, needing fewer supervisors and less activities of moving around that can distract examinee, as compared to the traditional administrative process that is usually long and tiring.
- e. Data management and analysis: CBT and CAT gives room for immediate feedbacks, students can easily get their scores immediately after the examination. The scores can also be collected for analysis to be used by teachers or examinee body. The system also generate a great amount on demographic data from test takers, that can be very helpful in research and analysis
- f. Technological advancement: the use of CAT and CBT, will bring to light advancement in educational technology as newer versions of the software will be updated to improve testing and assessment in education.

Research has shown that different level of institution has embraced the use of CBT in their institution, however, computer Adaptive test has seen very low usage in the educational sectors except in the use of games such as ‘Who Wants to be a Millionaire’ game show, and in some psychological test and administered by psychologists. CAT offer advantages such as instant feedback, reduced marking errors, and adaptive questioning, which could improve the validity and reliability of science assessments (Al-Amri, 2008). Additionally, in a research carried out by Ayanwale & Ndlovu (2024) on the feasibility of CAT of the national benchmark test: a simulation study carried out in south Africa, its stated that:

“CAT was recommended as an alternative approach for conducting NBTs due to its capability to accurately measure individual abilities and reduce the testing duration. For high-stakes assessments like the NBTs, fixed-length tests are preferred as they offer superior testing precision while minimizing item exposure rates.”

The advantages of CBT and CAT are numerous; hence they should be embraced by public secondary schools especially as external examination bodies have given it a chance all these years. Considering its numerous advantages. However, the feasible of the implementation of CBT and CAT in secondary schools in Nigeria has been greatly argues due to the numerous challenges facing the nations such as inadequate supply of electricity, infrastructure deficit, government scanty and weak budget allocation to education and seldom training and retraining of teachers especially in fairly urbanized Bwari Local Government area of Abuja. There have been several research carried out on students perceptions of computer based test in schools. Abasiama & Okpor (2025) carried out a study on the perception of CBT examination among students of selected tertiary institutions in cross river state, Nigeria. The findings from the research revealed that students perceived CBT questions formats as appropriate and engaging, students also reported that feedback was clear and contributed to their learning; generally the students agreed that CBT was more effective and objective aligned than the usual Paper and pencil test. It important to encourage the use of the CBT and CAT in public secondary schools as a means of assessment, especially as the students will be using it to write externals examination like JAMB and WAEC and also building the students confidence for it when they get into higher institutions.

Therefore, in order to achieve an effective assessment, adequate facilities should be put in place, such as computer systems, stable electricity, security, and maintenance of the system, so as to provide a suitable testing environment, and training of science teachers to use and adapt this method of assessment in their science classroom. Moreover, science students’ performance in external examinations has been a great concern to science educators. In a research carried out by Okocha (2022) on students perception of computer based testing in Kwara state, Nigeria, results from the study showed that students performed poorly in Mathematics, Chemistry and Physics, when CBT techniques was adopted for testing, results further showed the relationship between computer and anxiety and performance in Mathematics. Students’ familiarity with and the use of computers can greatly influence their performance in these examinations.

Statement of the Problem

The introduction of technology in education has greatly impacted assessment strategies worldwide. Computer-Based Testing (CBT) and Computer Adaptive Testing (CAT) are gaining visibility in assessments around the

world in education. These technologies offer improved test security, efficient, flexible, and reliable alternatives to traditional paper-based assessments (PBA). In February 2024, WAEC introduced the use of CBT for their external examination for private students, on the other hands Joint Admissions and Matriculation Board (JAMB) has been using the CBT for their students for a couple of years now. The National Examinations Council (NECO), was not left behind as they also introduced the use of CBT for their examinations. However, the researcher observed that while these innovations have been widely adopted in high-stakes testing, the feasibility of their implementation in secondary school-based assessments, particularly in science subjects, remains underexplored. Examining the crucial state of science education, and its relationships to national development. It is therefore paramount to ensure that effective assessment methods are put in place in such important subjects (such as Biology, Chemistry, Physics, Computer studies, and Mathematics). The assessment method for these subjects should not only evaluate knowledge but also enhance learning outcomes. Despite these potential benefits, the researchers have observed that very few schools has successfully implemented the use of CBT, however, the feasibility of implementing successfully the use of CAT in public schools was nearly not existence, no schools has implemented the use CAT, particularly in the Bwari Area Council, Abuja. Additionally, there is a lack of empirical studies assessing the feasibility, effectiveness, and perceptions of teachers and students regarding these testing modes in science education at the secondary school level. Therefore, this study seeks to empirically explore the perception of the feasibility of implementation of CBT and CAT in science subjects among secondary schools in the Bwari Area Council.

Purpose of the Study

This study main focus is to assess the perception of the feasibility of the implementation of CBT and CAT in science subjects among secondary schools in the Bwari Area Council, Abuja. Specifically, the study seek to:

1. Analyze the teachers and students' perceptions of the challenges of CBT and CAT in science subjects in senior secondary schools in the Bwari Area Council, Abuja.
2. Analyze the perceived potential impact of the use of computer- based and computer-adaptive testing on students' performance and engagement in science subjects in senior secondary schools in Bwari Area Council, Abuja.

Research Questions

1. What are teachers and students' perceptions of the challenges of computer-based testing and computer adaptive testing in science subjects in senior secondary schools in Bwari Local government area of Abuja?
2. What is the perceived potential impact of Computer-Based Testing (CBT) and Computer Adaptive Testing (CAT) on students' performance and engagement in science subjects in senior secondary schools in Bwari Area Council, Abuja?

Hypothesis

H₀₁: There is no significant difference between teachers and students' perceptions of the challenges of computer-based testing (CBT) and computer adaptive testing (CAT) in science subjects in secondary schools in Bwari Area Council, Abuja.

METHODOLOGY

The study adopted a descriptive survey research design. This design uses the sample data of an investigation to document, describe, and analyze what is present realities of the phenomenon being investigated (Ali, 2006). A total of 5804 senior science secondary students made up the Population of the study and 96 science teachers in public secondary schools in Bawri Area Council. Simple random sampling technique was used for selecting 5 schools from the 13 public schools for the study. A sample of 374 science students and 66 teachers was used for the study. The instrument for data collection was a self-made questionnaire titled "Computer-Based and Computer Adaptive Testing for Science Subjects in Secondary Schools in Abuja Questionnaire

(CBCATSSSSAQ)”. The instrument was divided into two sections; A and B. Section A has the demographics data for the respondent, while Section B was covering 2 variables of the study. It has 10 items, items 1-5 collected data on perceived challenges of CBT, and CAT implementation, and items 6 - 10 collected data information on perceived potential impact of students’ performance and engagement with the use of CBT and CAT. The questionnaire was structured using the four-point Likert - rating scale with a response mode of Strongly Agree – SA= 4, Agree- A- 3, Disagree –D= 2, Strongly Disagree –SD = 1. The instrument was validated by three experts in the Faculty of Science Education, Veritas University Abuja. 30 students and teachers were used for the trial test. This sample was not part of the initial sample marked out but they are part of the original population. Cronbach's alpha reliability was used; the trial test yielded a result of 0.92. The researcher administered the instrument with the help of a research assistant. Data collected were analyzed using means and standard deviations to answer the two (2) research questions, while the hypothesis was tested using a t-test at 0.05 level of significance. Aggregate mean score were computed by adding respondents rating across the five likert- scale items for each research question, each items was rated on a four point scale(4= strongly agree to 1= strongly disagree). The total possible score ranged from 5 to 20, with higher scores indicating greater perceptions of variables measured.

RESULTS

Mean and standard deviation is used to answer the research questions raised in the study. .

Research Question 1: What are teachers and students’ perceptions of the challenges of computer-based testing and computer adaptive testing in science subjects in secondary schools in Bwari Area Council, Abuja?

Table 1: Mean and standard deviation analysis showing teachers and students’ perceptions of the challenges of computer-based testing and computer adaptive testing in science subjects in secondary schools in Bwari Area Council, Abuja

Number of Teachers = 66; Number of Students = 374

S/N	Items	Level of Agreement				Mean Difference	Decision
		Teachers’ Perceptions		Students’ Perceptions			
		Mean	StD	Mean	StD		
1	There is inadequate access to computers and technological resources to conduct CBT and CAT effectively	3.03	1.02	3.01	1.06	0.02	Agreed
2	My school lacks sufficient internet connectivity to support CBT and CAT sessions	2.87	0.98	2.85	1.02	0.02	Agreed
3	Students face difficulties in using computers and technology for CBT and CAT due to lack of computer literacy	2.96	1.13	2.90	1.18	0.06	Agreed
4	There is insufficient technical support to resolve problems that occur during CBT and CAT sessions	3.09	1.04	3.07	1.05	0.02	Agreed
5	The current infrastructure (e.g., power	2.02	1.00	1.99	0.98	0.03	Disagreed

	supply, network reliability) is conducive to consistent use of CBT and CAT in assessments						
Aggregate Mean/Standard Deviation		2.79	1.03	2.76	1.06	0.03	Agreed

Scale mean = 2.50

Table 1 shows mean analysis of teachers and students' perceptions of the challenges of computer-based testing and computer adaptive testing in science subjects in secondary schools in Bwari Area Council, Abuja. The mean ratings of items 1, 2, 3, 4 and 5 gave average means of 2.79 and 2.76 for the teachers and students respectively which were above the cut-off point of 2.50 with a mean difference of 0.03. Both teachers and students' means were high, indicating that teachers and students agrees that there are noticeable challenges associated with computer-based testing and computer adaptive testing, especially as it relates to infrastructure inadequacies such as inadequate computer laboratories, unstable electricity supply, poor internet connectivity, and limited technical staff. This suggest that senior secondary schools in Bwari LGA, has insufficient infrastructures for the implementation of CAT and CBT. This research is in agreement with research carried out by Fehintola (2018) that showed that students took CBT examination among several challenges such as inadequate infrastructures, deplorable power supply, and in adequate trained manpower.

Research Question 2

Table 2: Mean and standard deviation analysis showing respondents' perceived potential impact of Computer Based Testing (CBT) and Computer Adaptive Testing (CAT) on performance and engagement in science subjects in senior secondary schools in Bwari Area Council, Abuja

S/N	Item	Level of Agreement				Mean	Std Dev.	Decision
		SA	A	D	SD			
6	The use of CBT and CAT motivates students to engage more actively in their learning process	177	51	71	141	2.60	1.30	Agreed
7	Students feel more confident in their ability to complete assessments when using CBT and CAT	164	25	137	114	2.54	1.23	Agreed
8	CBT and CAT make assessments more engaging and interactive, which helps maintain students' attention during exams	235	141	16	48	3.28	0.97	Agreed
9	Students find it easier to review and learn from their mistakes after taking CBT and CAT assessments due to immediate feedback	213	110	57	60	3.08	1.08	Agreed
10	The use of CBT and CAT reduces student anxiety during exams compared to traditional assessments	200	113	54	73	3.00	1.12	Agreed
	Aggregate Mean/Standard Deviation					2.90	1.14	Agreed

Scale Mean 2.50, n=440

Table 2 shows mean analysis of impact of Computer-Based Testing (CBT) and Computer Adaptive Testing (CAT) on students' performance and engagement in science subjects in secondary schools in Bwari Area Council, Abuja. From the Table, it could be observed that the mean values of 2.60, 2.54, 3.28, 3.08 and 3.00 were in agreement with items 6, 7, 8, 9 and 10 respectively, with an aggregate means of 2.90, this results shows that CBT and CAT can enhance student engagement, improve learning confidence, provides motivating feedback, Reduce examination anxiety and potentially enhance academic performance of science students. Consequently, this is to say both teachers and students perceive CBT and CAT as having positive impact on students' performance and engagement in science subjects in senior secondary schools in Bwari Area Council, Abuja.

Test of Hypothesis

H₀₁. There is no significant difference between teachers and students' perceptions of the challenges of computer-based testing (CBT) and computer adaptive testing (CAT) in science subjects in secondary schools in Bwari Area Council, Abuja.

Table 3: T-test analysis showing difference between teachers and students' perceptions of the challenges of computer-based testing (CBT) and computer adaptive testing (CAT) in science subjects in secondary schools in Bwari Area Council, Abuja

Groups	N	Mean	Std. Deviation	df	t – cal.	P-value	Sig	Decision
Teachers' perception	66	14.60	4.390	438	0.044	0.965	0.05	Not Significant
Students' perception	374	14.58	4.490					

Not Significant at $\alpha = 0.05$

Table 3 shows t-test analysis of difference between teachers and students' perceptions of the challenges of computer-based testing (CBT) and computer adaptive testing (CAT) in science subjects in secondary schools in Bwari Area Council, Abuja. The result revealed that the calculated value of t-test was 0.965. The pvalue was greater than 0.05 level of significance. Since the p-value was greater than 0.05 ($p > 0.05$), hypothesis 1 was therefore retained; indicating that there was no significant difference between teachers and students' perceptions of the challenges of computer-based testing (CBT) and computer adaptive testing (CAT) in science subjects in secondary schools in Bwari Area Council, Abuja. Furthermore, The table revealed no statistically significant difference between teachers' (M= 14.60, SD 4.39) and students' (M= 14.58, SD = 4.49) perceptions of challenges of CBT and CAT, $t(438) = 0.044$, $p = 0.965$. The effect size was negligible (Cohen's $d = 0.004$), this showed that no tangible differences between the two groups

DISCUSSION

In research question one, the study revealed that both teachers' and students' means were high, (Teachers mean scores of 2.79 and students mean scores of 2.76) was higher than the scale mean of 2.50, indicating that both groups generally agreed that significant challenges hinder the effective implementation of CBT and CAT. Therefore it is safe to conclude, that teachers and students perceived the challenges of computer-based testing and computer adaptive testing in science subjects in secondary schools in Bwari Area Council, Abuja. Also, in hypothesis one, the study showed that the calculated value of the t-test was 0.965. The p-value was greater than the 0.05 level of significance. Since the p-value was greater than 0.05 ($p > 0.05$), hypothesis 1 was therefore retained; indicating that there was no significant difference between teachers' and students' perceptions of the challenges of computer-based testing (CBT) and computer adaptive testing (CAT) in science subjects in secondary schools in Bwari Area Council, Abuja. Overall, the insignificant mean differences distributed across all items (0.02 to 0.06) shows that both groups have the same perceptions on the challenges of feasibility of implementing CBT and CAT. This agreement strengthens the validity of the findings,

implying further that the consistency in agreement suggest that the challenges to CBT and CAT feasibility of implementation are noticeable on multiple levels within the schools system as both implementers and beneficiaries identifies similar hurdles. This finding is line with the study carried out by Fehintola (2018) that noted that students took CBT assessment technique amidst a lot of challenges such as inadequate facilities, poor power supply, without computer technical knowhow. The finding from the study has some major implications, it's important for policy makers and government institutions must ensure a proper approach in providing ICT infrastructure to school, especially in semi- urban area like Bwari area councils. Dedicated ICT support staff should be employed in schools and constant training and retaining of staff and students to build confidence level in both staff and students.

In research question two, the study revealed that aggregate mean of 2.90 was greater than the scale mean of 2.50 which indicated that majority of the respondents agreed that the use of CBT and CAT can motivates students to engage more actively in their learning process, students feel more confident in their ability to complete assessments if CBT and CAT are being used, CBT and CAT can make assessments more engaging and interactive if implemented, which can helps maintain students' attention during exams, students will find it easier to review and learn from their mistakes if CBT and CAT assessments are used due to immediate feedback and the use of CBT and CAT can reduces student anxiety during exams compared to traditional assessments. Generally, the standard deviation values suggest that there is an agreement of all respondent that CBT and CAT when implemented can positively influence students' engagement, confidence, motivation, attentiveness, feedback utilization and above all reduce anxiety in science subjects. The highest mean scores (Mean = 3.28, SD = 0.97) was recorded for the items stating CBT and CAT make assessment more engaging and interactive. This shows that digital assessment formats can improve attentiveness and improve academic performance, this finding is in line with the study carried out by Jatau & Hamidu (2023). On the Impact of Computer-Based Test in Senior Secondary Schools on Candidates Performance in Utme in Bali Local Government Area of Taraba State, the research found out that, schools that didn't implement the use of CBT had high failure rates in external examination such as UTME, the study concludes that implementing the CBT system will help achieve better results.

CONCLUSION

The study assessed the perceptions of teachers and students regarding the feasibility of the implementation of computer-based and computer-adaptive testing in science subjects among senior secondary schools in the Bwari Area Council, Abuja. From the finding of the research, both teachers and students have positive perceptions regarding the adoption and use of CBT and CAT in science assessments. The respondent agrees that there are several challenges to the implementation of CBT and CAT in secondary schools in Bwari LGA, these challenges are unstable electricity, inadequate ICT facilities, untrained ICT and technical staff, digital divide existing between students and even teacher, inaccessibility to good internet connectivity, however, they were of the opinion that CBT and CAT can enhance students' engagement, motivation, confidence during examination if implemented in schools. The study concludes that the integration of technology-driven assessment methods in senior secondary schools in Bwari Area Council is widely accepted and holds significant potential for improving assessment practices and academic outcomes in science education.

RECOMMENDATIONS

Based on the findings, it was recommended that:

1. The federal Government and educational stakeholders can strengthen ICT facilities in schools by providing well equipped computer laboratories, reliable electricity supply, stable and free internet connectivity.
2. Teachers are encouraged to explore the use of alternative measures to assess students' ability, like the use of Google Forms, this can be done by continuous teacher professional development through capacity building workshops and in – service ICT training programs organized for teachers by FCT secondary education board.

3. School Principals should ensure that teachers integrates basic computer literacy modules into curriculum and ensure the right atmosphere is created to provide for regular practice session using CBT platforms.
4. A structured policy document for implementation of CBT and CAT should be developed with clear guidelines for deployment in schools.
5. Governments should initiates special intervention funds for schools with students from low socio-economic background and limited ICT infrastructures to reduce the existing digital divide.
6. There is room for further investigation into actual impact of CBT and CAT on students' academic achievement using experimental, Quasi- experimental, and mixed research method.

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