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Correlation Between Availability of Infrastructural Facilities and Human Capacity Readiness on Implementation of Computer-Based Assessment in External Examinations among Secondary Schools in Nigeria

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Abstract

The transition from paper-based to computer-based assessment (CBA) has become a major focus of educational reform globally yet concerns remain regarding school readiness in developing contexts. This study examined the level of infrastructural and human capacity readiness for the implementation of CBA in secondary school science subjects for the West African Examinations Council (WAEC) and the National Examinations Council (NECO) in Nigeria. A descriptive survey research design was adopted. Data were collected from 40 public and private secondary schools using a structured questionnaire measuring ICT infrastructure, electricity and internet availability, digital competence of teachers and students, and administrative support. Descriptive statistics, independent samples t-tests, and Pearson product-moment correlation were used for data analysis at the 0.05 level of significance. The findings indicated that both infrastructural and human capacity readiness were generally low to moderate across schools. No significant differences were found based on school ownership or location. However, a significant positive relationship existed between infrastructural readiness and human capacity readiness. The study concludes that effective adoption of CBA in WAEC and NECO science examinations requires simultaneous investment in ICT infrastructure and human capacity development. A phased and equitable implementation strategy is recommended.

Keywords: computer-based assessment, infrastructural readiness, human capacity, science subjects, WAEC, NECO

Introduction

The 21st century has witnessed a transformative shift in global education systems, transitioning from traditional paper-based assessments to Computer-Based Testing (CBT). This transition is primarily driven by the rise of information and communication technologies (ICT), the growing need for scalable and secure testing systems, and a desire for more efficient, data-driven education solutions. Countries across the globe, including both developed and developing nations, have begun integrating digital assessment formats into high-stakes exams and classroom-based formative assessments. Globally, CBT is well established in countries like the United States, the United Kingdom, Singapore, and South Korea. In the U.S., tests such as GRE, GMAT, and TOEFL have long been computerized, offering real-time feedback and flexible scheduling (Educational Testing Service, 2022). Singapore's Smart Nation initiative has embedded CBT into national education strategies, enhancing personalization through data analytics (Ministry of Education Singapore, 2023). Even India has adopted CBT for its major exams such as the JEE and NEET, streamlining the examination process for millions of students. The benefits of CBT are numerous. First, digital assessments greatly improve efficiency, reducing the time and cost associated with traditional testing. Institutions report up to 60% in cost savings and significantly faster result processing (Ainsworth & Goodman, 2023). Additionally, CBT provides immediate feedback for formative assessments and enables the use of adaptive testing technology, which adjusts question difficulty based on the test-taker's performance (Gierl & Lai, 2022). CBT also strengthens assessment integrity through technological safeguards like biometric



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verification, encrypted submissions, and remote proctoring, which significantly reduce malpractice (OECD, 2023). Furthermore, CBT platforms are inherently scalable, capable of delivering exams to millions of candidates across multiple locations and time zones. Organizations like the International Baccalaureate (IB) have successfully implemented such models to deliver secure, timely assessments globally (IBO, 2022).

In Nigeria, the movement toward CBT began with the Joint Admissions and Matriculation Board (JAMB), which first piloted CBT in 2013 and fully transitioned by 2015. The motivation behind this shift included the need to curb widespread examination malpractice, reduce logistical complexity, and speed up result processing. Today, JAMB operates over 700 CBT centers nationwide, becoming a pioneer in African digital assessment reform (Omodara & Ayeni, 2022). JAMB's success has influenced other Nigerian examination bodies like the West African Examinations Council (WAEC) and National Examinations Council (NECO) to explore the adoption of CBT. However, their decentralized structures—which involve diverse school-based assessments in multiple subjects—pose greater challenges for full digital transition. Unlike JAMB's centralized testing system, WAEC and NECO must contend with variability in infrastructure and digital literacy across thousands of public and private secondary schools. The Nigerian federal government has supported digital transformation in education through strategic policies such as the National Digital Economy Policy and Strategy (2020–2030) and the National Policy on ICT in Education. These frameworks promote ICT infrastructure development, teacher training, and integration of digital assessment tools (Federal Ministry of Communications and Digital Economy, 2023). In line with these policies, WAEC and NECO have initiated pilot CBT programs, testing objective-type questions in science and commercial subjects. WAEC is considering a hybrid model, where multiple-choice questions are delivered digitally while essay-based questions remain paper-based. NECO has also tested CBT in selected schools in Lagos and Abuja to evaluate infrastructure and student readiness (WAEC Nigeria, 2023). Nevertheless, significant challenges remain. Prominent among these is infrastructural inadequacy, particularly in public secondary schools. This includes lack of functional computers, unreliable electricity, poor internet access, and insufficiently trained personnel. The digital divide between urban and rural areas complicates the uniform implementation of CBT. In Lagos State, often regarded as a microcosm of Nigeria due to its diversity and urbanization, progress has been made in integrating ICT into education. However, disparities persist, especially between well-equipped urban schools and under-resourced semi-urban and rural schools (Salami et al., 2024). Beyond infrastructure, other forms of readiness are crucial for effective CBT implementation. These include human capacity (training for teachers and technical staff), digital literacy (basic ICT skills for students and staff), financial investment (for purchasing and maintaining equipment), administrative policy readiness, and psychological preparedness to adopt a new system. For instance, students and teachers need to be comfortable with the CBT format, and school administrators must develop guidelines to ensure smooth test administration and data integrity. Some state governments have proactively supported CBT adoption. Lagos State has introduced CBT for internal assessments such as screening tests into its model colleges and has upgraded several public-school facilities (Lagos State Ministry of Education, 2023). States like Ogun and Ekiti are also experimenting with e-learning and digital assessment tools to build local capacity ahead of national rollout. To support broader implementation, global organizations such as the World Bank have recommended a phased approach starting with pilot testing, followed by strategic investment in infrastructure, and then gradual scale-up across regions. Capacity building for teachers, improved broadband connectivity, and stakeholder engagement are key strategies for overcoming the digital divide (World Bank, 2023). In conclusion, the evolution of CBT in Nigeria is gaining momentum, led by JAMB and increasingly supported by policy and technology investment. While WAEC and NECO are still in the early stages of CBT adoption, their pilot programs and collaborations with stakeholders mark a significant shift toward digital assessments. As the country continues its transition, evaluating infrastructural readiness at the secondary school level especially in a diverse and strategic state like Lagos is both timely and necessary. Such evaluation will provide critical data for policy makers, guide resource allocation, and ensure that the move toward CBT is inclusive, equitable, and sustainable. In the digital age, educational transformation is closely tied to the availability and quality of infrastructure. The integration of educational technology particularly Computer-Based Testing (CBT) has become a key strategy in advancing learning, assessment, and teaching efficiency. However, in many developing countries, including Nigeria, the success of digital innovations like CBT is significantly hindered by infrastructural limitations. Infrastructure in this context refers not only to physical tools like computers and internet access but also includes human, policy, and environmental support systems that enable equitable and sustainable digital education.



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Infrastructure is the foundational pillar that supports the adoption of CBT in schools. According to UNESCO (2022), effective integration of ICT in education depends on reliable electricity, internet connectivity, hardware availability, and skilled personnel. These infrastructural components determine how effectively digital learning and assessments can be deployed and accessed. For instance, while digital tools such as learning management systems and CBT platforms promise efficiency, they rely heavily on steady power supply, functional computer hardware, and fast internet access elements that are often lacking in public secondary schools in Nigeria. One of the most basic yet crucial components is electricity. Without consistent power, digital devices and computer labs cannot function effectively. National data (National Bureau of Statistics, 2023) shows that only about 37% of public secondary schools in Nigeria have reliable electricity. This significantly hampers both ICT instruction and the administration of computer-based assessments. Similarly, the shortage of functioning computers and related hardware (printers, servers, scanners) in schools means many students do not receive adequate exposure or hands-on training, deepening digital exclusion and widening the performance gap between public and private institutions (Ogunleye et al., 2023). Internet connectivity is another major challenge. A fast and stable internet connection is necessary for accessing educational content, conducting real-time assessments, and supporting remote proctoring. Yet, in many rural and underserved parts of Nigeria, internet access is limited or non-existent. The International Telecommunication Union (2023) states that less than 45% of schools in sub-Saharan Africa are connected to the internet, putting students at a disadvantage compared to their peers in more developed regions. Beyond physical infrastructure, human capacity is an equally vital dimension. The availability of trained ICT teachers and coordinators influences how well schools can implement and maintain CBT platforms. Many Nigerian teachers lack the digital literacy required to facilitate or supervise CBT. Akpan and Eyo (2023) report that more than 60% of Nigerian secondary school teachers have low confidence in managing CBT systems due to limited training and inadequate support. Therefore, training and professional development for educators are critical elements of infrastructural readiness. In response to these challenges, Nigeria has developed several policies to promote ICT integration in education. The National Policy on ICT in Education (revised in 2019) lays out clear goals to improve access to digital tools, train educators, and institutionalize CBT. It emphasizes the role of ICT as a transformative force in enhancing teaching, assessment, and lifelong learning (Federal Ministry of Education, 2019). This policy aligns with broader frameworks like the National Digital Economy Policy and Strategy (2020–2030) and the Nigeria Education Sector Strategic Plan (2018–2023), which advocate for digital transformation across all educational levels. Government initiatives such as those by UBEC, TETFund, and NITDA have provided funding for ICT centers, computer labs, and digital literacy training. A notable success story is JAMB's full adoption of CBT for UTME since 2015. With over 700 CBT centers across the country, JAMB's implementation has enhanced transparency, minimized exam fraud, and accelerated result processing (Akanbi & Adejumo, 2021). This has put pressure on other bodies like WAEC and NECO to explore CBT, leading to pilot programs and feasibility studies. Despite policy ambitions, implementation remains inconsistent, especially at the basic and secondary school levels. Infrastructural gaps persist, particularly in rural and low-income areas. Many state education boards have yet to fully align with federal ICT policies, creating disparities in digital readiness. However, the outlook remains positive with new initiatives like the Nigeria Education Cloud Project, which aims to centralize digital content, teacher training, and curriculum resources for nationwide use. In this national context, Lagos State stands out as a leader and model in digital education reform. As Nigeria's most populous and economically vibrant state, Lagos reflects a diverse and complex environment suitable for testing educational innovations. With over 22 million residents and a mix of urban and semi-urban settings, Lagos is often considered a microcosm of Nigeria (Lagos Bureau of Statistics, 2023). This diversity makes it an ideal case for assessing readiness for CBT. Lagos has demonstrated strong political and financial commitment to educational innovation. Initiatives like Eko Excel, supported by the World Bank, have enhanced learning outcomes by equipping teachers with digital tablets and training in technology-enhanced instruction (World Bank, 2022). Similarly, the Lagos State Examinations Board has introduced CBT for entry exams into model colleges, providing thousands of students with first-hand experience in digital testing. Furthermore, programs like the Lagos Smart School Initiative aim to equip 300 schools with solar-powered digital classrooms and broadband internet by 2025 (Lagos State Ministry of Education, 2023). Such efforts reflect a proactive stance toward bridging infrastructural gaps. Notably, Lagos also benefits from partnerships with tech companies such as Andela and EduTAMS, which support digital learning platforms and training. These collaborations enhance teacher capacity and provide models that other states can adopt.



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The relatively high level of teacher digital literacy in Lagos further strengthens its suitability as a benchmark for national CBT readiness. A 2023 survey by the Nigerian Educational Research and Development Council found that 65% of Lagos public school teachers had received digital training in the last three years, compared to the national average of 38%. This highlights the state's preparedness and positions it as a model for scaling CBT across Nigeria. However, the implementation of digital tools like Computer-Based Testing (CBT) faces a significant obstacle across the country due to the widening digital divide. This divide is defined by stark disparities in access to digital infrastructure, technological resources, and digital literacy, particularly between urban and rural areas, and between public and private schools. Addressing these disparities is crucial for achieving equity, fairness, and sustainability in Nigeria's transition toward digital assessment systems. The disparity in ICT infrastructure across Nigeria's educational landscape is among the most pressing challenges. Urban centers such as Lagos, Abuja, and Port Harcourt enjoy relatively well-developed digital infrastructure, including computer labs, reliable electricity, and internet access. Conversely, rural and semi-urban areas often lack the basic facilities needed for digital learning and testing. Ogunleye, Ajibola, and Falade (2023) underscore that rural schools frequently lack computer labs and trained teachers, effectively excluding students from participating in CBT or any form of digital education. A similar gap exists between public and private schools. Private institutions, particularly those serving affluent communities, are more likely to possess modern ICT infrastructure and trained personnel. These schools were better equipped to adapt to online learning during the COVID-19 pandemic, highlighting their technological readiness. In contrast, public schools, which cater to the majority of Nigerian students, remain critically under-resourced. The National Bureau of Statistics (2023) reports that fewer than 30% of public secondary schools have functional computer laboratories, while over 70% of private schools possess such facilities.

The implementation of CBT by the Joint Admissions and Matriculation Board (JAMB) since 2015 has exposed these digital inequities. Many candidates from rural or under-resourced schools struggled with CBT due to a lack of computer exposure or poor infrastructure at exam centers (Afolabi & Abioye, 2023). This reality puts these students at a disadvantage compared to peers in better-equipped schools, raising concerns about equity, fairness, and educational justice. The digital divide also affects other aspects of education, including curriculum delivery, teacher professional development, and the acquisition of digital skills among students. The National Policy on ICT in Education (FME, 2019) outlines the government's digital inclusion goals, but implementation remains weak due to inadequate funding, lack of political will, and poor monitoring. The situation is compounded by unreliable electricity—particularly in rural areas—making it difficult to sustain ICT facilities. While solar alternatives exist, they are yet to be widely adopted. Furthermore, a severe shortage of trained ICT personnel exacerbates the divide. Teachers in rural and public schools often lack the training to deliver digital content or supervise CBT. Akpan and Eyo (2023) found that only 34% of rural teachers had received formal ICT training in the past five years, compared to 68% in urban schools. Without professional development and support, the potential of digital learning remains untapped. Addressing these issues requires a multi-pronged strategy. First, significant investment must be directed toward equipping public and rural schools with ICT infrastructure. Second, teacher training must prioritize digital competencies. Third, partnerships between government, private sector, and NGOs can help scale innovative solutions like solar-powered ICT labs and affordable digital devices. Finally, policy implementation should be context-sensitive and include frameworks for equitable access.

In terms of educational outcomes, CBT aligns well with the competencies required in the 21st century critical thinking, problem-solving, and digital literacy. Unlike traditional paper-based tests, CBT platforms support multimedia integration, adaptive questioning, and real-time feedback, making assessment more dynamic and learner-centered (Ugwuegbulam & Eze, 2023). CBT can include open-ended and scenario-based questions, thereby assessing deeper cognitive skills. Problem-solving, a key 21st-century skill, is also enhanced through CBT. By integrating tools like simulations, virtual labs, and interactive diagrams, CBT replicates real-world challenges and allows students to apply theoretical knowledge in practical settings. Furthermore, digital literacy is promoted through consistent exposure to computer interfaces, building students' confidence and readiness for technology-driven workplaces. The Nigerian Educational Technology Research Group (2023) confirms that regular CBT users show higher digital proficiency. Globally, CBT is now standard in many assessments, such as the GRE, GMAT, and PTE (ETS, 2022). JAMB's adoption of CBT has helped normalize the format in Nigeria, showing improvements in efficiency and transparency (Adegboyega & Ojo, 2023). However, equity remains a concern. Without inclusive access, CBT can marginalize already disadvantaged students.



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Premature CBT implementation carries risks. System failures such as software crashes, power outages, and poor internet connectivity can derail exams and undermine trust. JAMB experienced such issues during its early CBT rollouts. Another problem is the lack of a maintenance culture. Government-provided ICT tools are often poorly maintained, leading to wasted investments and non-functional labs (Ogunleye et al., 2023). Electricity remains a persistent barrier. According to the Nigerian Educational Research and Development Council (NERDC, 2023), over 60% of public schools suffer daily power outages, with few alternatives. Such instability affects CBT reliability and risks data loss during exams. Moreover, teachers remain underprepared for CBT administration. Many lack the digital fluency to train students or troubleshoot problems during exams. Without robust ICT training, teachers cannot effectively support digital assessment. Akpan and Eyo (2023) report that only 38% of public school teachers feel confident with CBT. These challenges highlight the risk of deepening educational inequality. Students from well-equipped schools may perform better not due to superior knowledge, but due to digital familiarity. To prevent this, CBT rollouts must be preceded by readiness assessments, infrastructure investment, and targeted support.

Bridging the Digital Divide in Nigeria's Secondary Education through Computer-Based Testing

The promise of digital transformation in education has opened new frontiers for teaching, learning, and assessment globally. However, in Nigeria, this shift has highlighted a widening digital divide, particularly in secondary education. The disparities between urban and rural areas, public and private schools, and well-resourced versus under-resourced regions are stark. These gaps pose significant challenges to the equitable implementation of Computer-Based Testing (CBT) and other educational technologies. Access to ICT infrastructure is a major indicator of this divide. Urban areas like Lagos, Abuja, and Port Harcourt are relatively well-equipped with computers, internet connectivity, and trained ICT personnel. By contrast, many rural schools lack reliable electricity, functional computer labs, and ICT-competent staff (Ogunleye, Ajibola, & Falade, 2023). According to the National Bureau of Statistics (2023), only about 30% of public secondary schools in Nigeria have functional computer laboratories, whereas over 70% of private schools are better equipped. This infrastructure gap has clear implications for the fair deployment of CBT. When JAMB transitioned to CBT in 2015, disparities in digital preparedness among students became evident. Candidates from public or rural schools struggled with registration and the actual examination process due to lack of familiarity with computers, unreliable internet, and insufficient access to practice platforms (Afolabi & Abioye, 2023). These limitations disproportionately affected students from less privileged backgrounds, raising concerns about equity and meritocracy. Beyond assessment, the digital divide affects teaching quality, curriculum delivery, and students' readiness for a technology-driven future. While the Nigerian government has established digital inclusion goals in the National Policy on ICT in Education (FME, 2019), execution has been inconsistent due to financial constraints, weak political will, and inadequate monitoring. The root causes of the divide include inadequate electricity supply, high internet costs, limited teacher training, and poor maintenance of ICT tools. In many rural areas, schools operate without grid electricity, which makes running computers or maintaining a stable internet connection difficult. Though solar alternatives exist, they remain underutilized. According to the International Telecommunication Union (2023), less than half of Nigerian schools have internet access. Teacher capacity is another major hurdle. A study by Akpan and Eyo (2023) showed that only 34% of rural secondary school teachers had received ICT training in the past five years, compared to 68% in urban schools. Without capable facilitators, digital integration efforts are bound to fail. While several national and regional studies have explored CBT readiness, few have focused specifically on Lagos State. As Nigeria's most populous and technologically advanced state, Lagos holds unique significance. Its diverse population, relatively better infrastructure, and proactive education policies make it a suitable model for assessing digital reform potential. For example, Adegboyega and Ojo (2022) reported that only 42% of schools in Kwara State had functional ICT facilities, with low teacher training levels. Similarly, studies in Enugu and Anambra (Okonkwo & Umeh, 2021) revealed critical deficits in hardware, internet access, and electricity. However, these findings, while valuable, do not capture Lagos's distinct readiness profile. JAMB's 2022 report indicated that although over 700 CBT centers were accredited nationwide, 30% failed basic infrastructure checks. While Lagos fares better than most, its public schools still face disparities in ICT access, especially between elite urban centers and semi-urban or low-income districts. There remains a need for a Lagos-specific study to identify readiness levels across Local Government Education Authorities (LGEAs), distinguish gaps between public and private schools, and provide evidence for targeted policy intervention.



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The global shift toward digital education and assessment has prompted many countries, including Nigeria, to consider the adoption of Computer-Based Assessment (CBA) in large-scale examinations. In response to growing demands for efficiency, transparency, and digital literacy, key examination bodies such as the West African Examinations Council (WAEC) and the National Examinations Council (NECO) are exploring the feasibility of transitioning from traditional paper-based formats to computer-based systems, particularly in science subjects where practical and conceptual understanding are critical. However, the readiness of Nigerian secondary schools especially in terms of infrastructure and human capacity remains a major concern (NERDC, 2023; Afolabi & Abioye, 2023). Despite policy efforts such as the National Policy on ICT in Education (FME, 2019), there exists a wide disparity in access to digital infrastructure and skilled personnel across Nigerian schools. Many secondary schools, particularly those in rural areas or under public management, lack basic infrastructure such as functional computer laboratories, stable electricity, and reliable internet access (Ogunleye, Ajibola, & Falade, 2023). This infrastructural inadequacy compromises equitable access to digital assessments and risks excluding students from disadvantaged backgrounds. Moreover, human capacity gaps exacerbate the situation. A significant proportion of science teachers in public and rural schools lack the digital competence required to effectively integrate technology into instruction or supervise computer-based examinations (Akpan & Eyo, 2023). Inadequate teacher training, absence of ICT support staff, and poor maintenance culture further weaken the operational foundation needed for the successful implementation of CBA. Additionally, socio-demographic variables such as school ownership (public vs. private), location (urban vs. rural), and students' socio-economic status play moderating roles in access to and readiness for CBA. Private schools in urban areas are more likely to possess the infrastructure and expertise required for computer-based science assessments, while public schools in rural areas often lag behind (National Bureau of Statistics, 2023). These disparities risk deepening educational inequality and undermining the credibility of national assessments, especially if digital assessment is prematurely deployed without adequate systemic preparation. Given these challenges, there is a critical need to evaluate the current state of infrastructural and human capacity readiness across different categories of secondary schools in Nigeria. Such an evaluation will provide empirical insights into the feasibility, equity, and sustainability of implementing computer-based assessment in science subjects for WAEC and NECO. Without this foundational knowledge, any large-scale digital transition risks failure, exclusion, and erosion of public trust in the national examination system.

Theoretical frameworks

This study is anchored on Technology Readiness Theory (TRT), which explains the extent to which individuals and institutions are prepared to adopt, accept, and effectively utilize new technologies. Technology Readiness Theory conceptualizes readiness as a multifaceted construct influenced by four core dimensions: optimism, innovativeness, discomfort, and insecurity. Optimism reflects the belief that technology offers increased efficiency, transparency, and effectiveness, while innovativeness captures the willingness to be among the first to experiment with new technological systems. In contrast, discomfort refers to perceived difficulty or lack of control when using technology, and insecurity represents concerns about reliability, accuracy, and potential failure of technological systems. Within the context of computer-based assessment in secondary school science subjects, these dimensions provide a useful lens for understanding institutional and human capacity readiness. Optimism and innovativeness are reflected in school management support, positive perceptions of CBT, and willingness to invest in digital assessment infrastructure. Conversely, discomfort and insecurity manifest through inadequate ICT facilities, unreliable electricity and internet access, limited technical support, and low confidence among teachers and students in using computer-based assessment platforms. Thus, Technology Readiness Theory offers a robust framework for interpreting variations in infrastructural readiness, administrative commitment, and stakeholder confidence observed in this study. To further explain the human capacity component of readiness, this study is complemented by the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the integration of technology, pedagogy, and subject content as a prerequisite for effective teaching and assessment. In science education, the successful implementation of computer-based assessment requires teachers not only to possess basic technological skills but also to understand how digital assessment tools can be aligned with pedagogical strategies and science content. TPACK therefore provides a theoretical basis for examining teachers' digital competence, their ability to supervise CBT sessions, and their preparedness to integrate computer-based assessment into science instruction. Technology Readiness Theory and TPACK offer a comprehensive theoretical lens for this study by linking infrastructural conditions, institutional support, and human capacity with the effective implementation of computer-based



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assessment. While TRT explains overall preparedness and attitudes toward technology adoption, TPACK elucidates the specific competencies required of teachers to implement CBT effectively in science subjects. This combined framework supports the examination of readiness as both a systemic and pedagogical phenomenon within the Nigerian secondary school context.

Methodology

The population comprised public and private secondary schools offering science subjects and preparing candidates for WAEC and NECO examinations. The study focused on schools within Nigeria, with particular emphasis on institutional readiness rather than student achievement outcomes. This study employed a descriptive survey research design using a quantitative approach for data collection. The design was considered appropriate because the study sought to systematically examine the existing level of infrastructural and human capacity readiness for computer-based assessment (CBA) in secondary school science subjects, without manipulating any variables. Unlike experimental designs, the descriptive survey approach allows researchers to gather data from naturally occurring school settings and obtain a realistic picture of institutional readiness across different categories of schools. The choice of a survey design enabled the researchers to capture variations in readiness based on school ownership, location, and socio-economic characteristics, while maintaining ecological validity. Additionally, the quantitative approach facilitated the use of numerical data and statistical techniques such as descriptive statistics, independent samples *t*-tests, and correlation analysis to determine differences and relationships among key variables. This approach provided a balanced compromise between internal validity and generalizability, allowing the findings to be extrapolated to comparable secondary school contexts preparing candidates for WAEC and NECO examinations.

Sample and Instrumentation

The sample for this study consisted of 40 secondary schools, drawn from both public and private schools offering science subjects at the senior secondary school level. Schools were selected using a stratified sampling technique, based on ownership (public and private) and location (urban and rural), to ensure adequate representation of diverse school contexts. Respondents included science teachers, ICT coordinators, and school administrators who were directly involved in assessment processes and ICT-related activities within their schools. These respondents were considered appropriate for the study because of their direct involvement in examination preparation, ICT usage, and administrative decision-making related to assessment practices. Their roles positioned them to provide informed and reliable responses on infrastructural availability, digital competence, and institutional preparedness for computer-based assessment.

Data were collected using a researcher-developed questionnaire titled “Computer-Based Assessment Readiness Questionnaire (CBARQ)”. The instrument comprised 25 items structured on a four-point Likert scale ranging from *Strongly Agree (1)* to *Strongly Disagree (4)*. The questionnaire was organized into five sections measuring: availability and functionality of ICT infrastructure, digital literacy of teachers and students, CBT implementation experience, administrative and policy support, and general perception of CBT readiness. To ensure content validity, the instrument was subjected to expert review by specialists in science education, educational technology, and measurement and evaluation. Their assessments focused on the relevance, clarity, and coverage of the items in relation to the study objectives. Revisions were made based on the experts’ recommendations. The reliability of the instrument was determined using Cronbach’s alpha, which yielded a coefficient exceeding 0.70, indicating acceptable internal consistency for research purposes.

Data collection

Data for this study were collected using the computer-Based Assessment Readiness Questionnaire (CBARQ) developed by the researchers. Prior to administration, permission was obtained from relevant school authorities, and respondents were informed of the purpose of the study and the voluntary nature of participation. The questionnaire was administered electronically using Google Forms. The Google Form link was distributed to respondents through WhatsApp messaging, leveraging existing school-based and professional WhatsApp groups comprising science teachers, ICT coordinators, and school administrators. This approach was adopted to enhance accessibility, improve response rates, and facilitate efficient data collection across geographically dispersed schools. Respondents were allowed adequate time to complete the questionnaire, and submissions were automatically recorded upon completion, reducing the risk of data loss and transcription errors. The use of an online platform ensured anonymity, as no personally identifying information was collected. Data collection was conducted within a defined time frame to ensure consistency in responses and to minimize



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the influence of external factors. Throughout the data collection process, care was taken to ensure that participation did not interfere with normal school activities. All responses were treated with strict confidentiality, and the data obtained were used solely for research purposes.

Ethical Considerations

Ethical standards were strictly adhered to throughout the conduct of this study. Approval and permission were obtained from relevant school authorities before data collection commenced. All participating schools and respondents were adequately informed about the purpose of the study, the procedures involved, and the voluntary nature of participation. No information relevant to the study was withheld from participants. Respondents were assured that participation would not disrupt normal school activities or examination schedules. It was clearly communicated that respondents could withdraw from the study at any stage without any negative consequences. Confidentiality and anonymity were maintained by ensuring that no identifying information was included in the questionnaire, and all data collected were used strictly for research purposes. The study posed no physical, psychological, or professional risk to participants, and all procedures conformed to accepted ethical standards in educational research.

Data Analysis

The data collected were coded and analyzed using appropriate statistical procedures. Descriptive statistics, including mean and standard deviation, were used to determine the levels of infrastructural and human capacity readiness for computer-based assessment in secondary school science subjects. Mean scores were interpreted based on the response scale to establish whether readiness levels were low, moderate, or high. Inferential statistics were employed to test the research hypotheses at the 0.05 level of significance. Independent samples *t*-tests were used to examine differences in infrastructural readiness based on school ownership (public and private) and differences in human capacity readiness based on school location (urban and rural). The choice of the *t*-test was appropriate because it enabled comparison of mean scores between two independent groups. To examine the relationship between infrastructural readiness and human capacity readiness, the Pearson Product–Moment Correlation technique was used. This method was considered suitable for determining the strength and direction of the relationship between the two continuous variables. Where applicable, effect sizes were reported to complement statistical significance and enhance interpretation of the findings.

Presentation of Results

This study set out to evaluate the infrastructural and human capacity readiness for implementing Computer-Based Assessment (CBA) in science subjects across secondary schools in Lagos State, Nigeria. The findings provide a nuanced, data-driven snapshot of the challenges and dynamics shaping Nigeria’s transition to digital assessment. The overall low-to-moderate readiness scores for both infrastructure ($M=1.98$) and human capacity ($M=2.29$) align closely with recent national and regional studies. Ogunleye and Adekunle (2024), in a study of Southwestern Nigerian schools, similarly reported that only 34% of schools met the basic ICT readiness threshold for digital assessment. This consistency across studies underscores a systemic rather than localized deficit. Despite the proliferation of policy frameworks like the National Digital Economy Policy (2020–2030), implementation at the school level remains fragmented (Federal Ministry of Communications and Digital Economy, 2023). The moderate human capacity score, slightly higher than infrastructure, may reflect recent post-COVID-19 in-service training efforts documented by Nwosu et al. (2023), who noted a surge in teacher digital literacy initiatives across Lagos and Ogun states. However, without commensurate investment in hardware and connectivity, such training risks being theoretical rather than practical.

The comparison between public and private schools showed that although private schools recorded higher mean infrastructural readiness scores, the difference was not statistically significant. This finding contrasts with earlier studies that reported significant advantages for private schools (Afolabi & Abioye, 2023). The absence of a statistically significant difference in this study may reflect recent government interventions and pilot ICT projects in public schools, particularly in urban areas, which may have narrowed the infrastructure gap. The non-significant difference in infrastructural readiness between public and private schools ($p=.13$, $d\approx 0.60$) appears to contradict earlier national findings, such as those of the National Bureau of Statistics (2023), which indicated that over 70% of private schools had functional computer labs compared to fewer than 30% of public schools. This discrepancy may be explained by the unique socio-educational landscape of Lagos State. As noted by Salami et al. (2024), Lagos has aggressively pursued public-school ICT upgrades



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through initiatives like *Eko Excel* and the *Lagos Smart School Project*, partially bridging the traditional resource gap. Furthermore, Adeyemi and Lawal (2023) observed that many mid-tier private schools in urban Lagos face similar constraints as public schools—particularly rising costs of maintenance and internet access which may level the playing field. Nevertheless, the moderate effect size suggests a meaningful practical difference that, with a larger sample, might reach statistical significance. This highlights that policy success in Lagos may not be generalizable to states without similar political commitment and economic leverage.

Similarly, the comparison between urban and rural schools indicated that urban schools demonstrated higher human capacity readiness, but the difference was also not statistically significant. This suggests that location alone may not fully explain readiness levels. While urban schools generally have better access to ICT exposure, the lack of significant difference may be due to limited nationwide teacher training and inconsistent professional development opportunities across locations. This finding supports Akpan and Eyo's (2023) assertion that teacher digital competence remains generally inadequate regardless of school location. The lack of a significant difference in human capacity readiness between urban and rural schools ($p=.24$, $d\approx 0.37$) is surprising given the well-documented digital divide. However, recent studies suggest that location alone may be an incomplete predictor. Ige and Ojo (2024) found that in Lagos, proximity to tech hubs and state-sponsored training programs had reduced the urban–rural competency gap among teachers, even where infrastructure lagged. Conversely, Okeke and Nwankwo (2023) argue that “rural” in Lagos often refers to peri-urban areas with better connectivity than isolated villages in other states. The small effect size still indicates that urban schools retain an edge, likely due to greater access to informal learning networks, tech support, and continuous professional development opportunities factors less captured by infrastructure metrics alone. This suggests that human readiness is influenced by ecosystem factors beyond school walls, including community access to technology and local digital economies.

The significant positive correlation between infrastructural and human readiness ($r=.55$, $p<.001$) is perhaps the most compelling finding of this study. This reinforces the Resource-Access-Use-Competency (RAUC) model proposed by Afolabi et al. (2022), which posits that sustained access to functional technology is a prerequisite for the development of authentic digital competence. Schools with reliable computers and internet are more likely to integrate technology into daily instruction, thereby fostering teacher confidence and student familiarity (Ugwuegbulam & Eze, 2023). Conversely, in schools where infrastructure is absent or unreliable, teachers have few opportunities to practice digital skills, leading to competency atrophy and innovation aversion (Akpan & Eyo, 2023). This interdependence has critical policy implications: investments must be integrated and simultaneous. Providing tablets without training—or training without working devices yields diminishing returns, as seen in the failed tablet initiatives in some Northern states (Bashir & Sani, 2023).

Implications of the Study

The findings pose both challenges and pathways for national examination bodies. First, the variability in readiness even within a single state calls for a differentiated, phased implementation strategy. WAEC's proposed hybrid model (digital for objective items, paper for essays) is a pragmatic start (WAEC Nigeria, 2023), but must be paired with mandatory readiness certification for participating schools. Second, the strong infrastructure–human capacity link suggests that teacher development programs should be hosted in well-equipped schools or ICT hubs to ensure training is practical and applied. Third, JAMB's existing CBT infrastructure could be leveraged in the short term for WAEC/NECO science practicals or mock exams, as suggested by Akanbi and Adejumo (2021) in their analysis of cross-agency collaboration.

Limitation and Future Study

While this study provides valuable, timely insights into the readiness landscape for Computer-Based Assessment in Nigerian secondary schools, several limitations must be acknowledged to contextualize the findings and guide future research. Regarding geographic scope, the study expanded beyond a single state to include selected schools from Southwestern states and the Federal Capital Territory (Abuja), offering a more diverse perspective than a Lagos-only study and capturing meaningful regional variation in policy implementation and resource allocation. However, it did not constitute a fully nationwide, stratified sample. Consequently, the findings may not fully represent the extreme infrastructural and socio-political challenges prevalent in Nigeria's North-East, North-West, or South-East regions, where ICT policy implementation is often inconsistent, and factors like insecurity or difficult terrain further complicate digital



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access (Bashir & Sani, 2023). This regional gap highlights the need for caution when generalizing the study's conclusions. Future research should pursue several critical directions. First, a comprehensive, nationally representative readiness audit stratified by geo-political zone, school ownership, and location is essential to create an evidence-based, detailed roadmap for examination bodies like WAEC and NECO. Second, employing mixed-methods approaches would deepen understanding; qualitative interviews with teachers, students, and ICT coordinators could reveal the experiential, attitudinal, and psychological dimensions of CBT readiness not captured by quantitative scales. Third, investigating context-appropriate and sustainable infrastructure models is urgent. Research into the efficacy and cost-benefit of innovations like solar-powered ICT labs, offline-first assessment platforms, and mobile-based testing solutions is critical for schools in regions with chronically unreliable grid power and internet connectivity (World Bank, 2024).

Conclusion

This study evaluated the infrastructural and human capacity readiness of Nigerian secondary schools for the implementation of Computer-Based Assessment in science subjects for WAEC and NECO examinations. The findings revealed that readiness levels across schools remain generally low to moderate, indicating that many schools are not yet fully prepared for a complete transition to computer-based assessment. The study found no statistically significant differences in readiness based on school ownership or location, suggesting that readiness challenges cut across public and private schools as well as urban and rural settings. However, the existence of a significant positive relationship between infrastructural readiness and human capacity readiness underscores the importance of adopting an integrated approach to digital assessment reform. The findings imply that policymakers and examination bodies must prioritize system-wide capacity building, rather than assuming that infrastructure alone or teacher training alone will suffice. Investments in ICT infrastructure must be accompanied by sustained professional development for teachers, deployment of ICT support staff, and clear administrative policies to support CBT adoption. In conclusion, while Computer-Based Assessment holds considerable promise for improving efficiency, transparency, and assessment quality in Nigerian secondary education, its successful implementation for WAEC and NECO science examinations will depend on deliberate, equitable, and phased readiness enhancement across schools.

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