EXAMINING THE IMPACT OF COMPUTER-BASED ASSESSMENT ON HIGHER EDUCATION STUDENT PERFORMANCE IN KANO, NIGERIA

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by

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DEDICATION

This thesis is dedicated to

My late parents Alhaji Bello Abdullahi and Hajiya Halima Zubairu. May their souls rest in peace.

My wonderful wife, Hauwa Ado, supports me in achieving my goals. May Allah reward her.

My blissful children, Muhammad, Abdul, Ni'ima, Raudah, and Mubaraka, have been my pillars of strength and support. May Allah bless them.

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LIST OF ABBREVIATIONS

JAMB	Joint Admission and Matriculation Board
UTME	Unified Tertiary Matriculation Examination
CAT	Computerised Adaptive Testing
LMS	Learning Management System
CBA	Computer-Based Assessment
CBT	Computer-Based Test
E-assessment	Electronic Assessment
E-examination	Electronic Examination
IT	Information Technology
ICT	Information and Communication Technology
IS	Information System
PPT	Paper-Pencil Test
DBT	Dual-Based Test
GE	Goal Expectancy
TR	Technology Readiness

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MEMERIKSA IMPAK PENTAKSIRAN BERASASKAN KOMPUTER TERHADAP PRESTASI PELAJAR PENGAJIAN TINGGI DI KANO, NIGERIA

ABSTRAK

Meskipun para sarjana telah meneroka niat pemacuan Penilaian Berasaskan Komputer (CBA) dikalangan pelajar, maklumbalas sebenar terhadap CBA, dan impak CBA terhadap prestasi pelajar, namun hubung kait antara niat-prestasi masih kurang diterokai. Oleh itu, kajian ini bertujuan untuk menyiasat kesan CBA terhadap prestasi pelajar di Kano, Nigeria, dan mencadangkan bahawa faktor seperti jangkaan matlamat pelajar dan kesediaan teknologi mempengaruhi prestasi mereka dengan sistem CBA. Tambahan pula, kajian ini meneroka bagaimana kepuasan perkhidmatan mempengaruhi kepuasan keseluruhan dan seterusnya mempengaruhi prestasi pelajar dengan sistem CBA. Kajian ini menggabungkan Model Pengesahan Jangkaan (ECM), Model Kejayaan Sistem Maklumat (ISSM), dan Model Kesediaan Teknologi (TRI 2.0) untuk menguji rangka kerja penyelidikan. Data tinjauan dikumpul daripada 459 pelajar sarjana muda di institusi pengajian tinggi terpilih di Kano yang menggunakan sistem CBA untuk menguji rangka kerja. Kajian ini mendedahkan bahawa impak sistem CBA ke atas prestasi individu pelajar pengajian tinggi di negeri Kano bukan sahaja bergantung kepada niat berterusan sistem, tetapi juga pada kepuasan pelajar. Penemuan seterusnya menunjukkan bahawa jangkaan matlamat dan kesediaan teknologi mempunyai pengaruh negatif ke atas hubungan antara niat berterusan dan prestasi individu. Penemuan ini mencadangkan bahawa niat penggunaan berterusan, kepuasan keseluruhan, jangkaan matlamat, dan kesediaan teknologi membantu prestasi individu dengan sistem CBA. Di samping itu, keputusan menunjukkan

bahawa kepuasan perkhidmatan menjadi perantara antara kualiti sistem, kualiti perkhidmatan dan kepuasan keseluruhan. Selain itu, kajian juga mendapati bahawa kepuasan perkhidmatan adalah faktor paling penting yang mempengaruhi kejayaan keseluruhan sistem CBA di dalam kampus. Secara teori, kajian ini menyumbang kepada sorotan kajian semasa dengan integrasi dua model terkenal dan indeks kesediaan teknologi (TRI 2.0) ke dalam rangka kerja yang komprehensif. Ia meneliti kepuasan perkhidmatan sebagai faktor perantara dan mempertimbang jangkaan matlamat dan kesediaan teknologi sebagai pembolehubah selarian menyederhana. Dapatan kajian ini mempunyai implikasi praktikal untuk pengurus dan penggubal dasar dalam pendidikan tinggi di negeri Kano dan Nigeria menyedari pengaruh yang mempengaruhi prestasi individu CBA dalam institusi. Selain itu, model yang dicadangkan oleh kajian ini bertindak sebagai instrumen diagnostik untuk pentadbir institusi dan pengurus CBA menilai kesan CBA dalam institusi.

EXAMINING THE IMPACT OF COMPUTER-BASED ASSESSMENT ON HIGHER EDUCATION STUDENT PERFORMANCE IN KANO, NIGERIA

ABSTRACT

Although scholars have explored the drivers of students' Computer-Based Assessment (CBA) intention, actual responses to CBA, and the impact of CBA on student performance, the intention-performance link remain under-explored. Thus, this study aimed to investigate the impact of CBA on student performance in Kano, Nigeria and suggests that factors such as students' goal expectancy and technology readiness influence their performance with the CBA system. Additionally, this study explores how service satisfaction affects overall satisfaction and thus influences student performance within the CBA system. The study merged the Expectation Confirmation Model (ECM), the Information System Success Model (ISSM), and the Technology Readiness Model (TRI 2.0) to examine the research framework. Survey data collected from 459 undergraduate students in selected higher education institutions in Kano who used the CBA system to test the framework. The study reveals that the impact of the CBA system on individual performance of Kano state higher education students depends not only on the continuance intention of the system but also on students' satisfaction. The findings further indicate that goal expectancy and technology readiness negatively influence the connection between continuance intention and individual performance. These findings suggest that continuance use intention, overall satisfaction, goal expectancy, and technology readiness facilitate the individual performance of the CBA system. In addition, the results demonstrated that service satisfaction mediates between system quality, service quality, and overall satisfaction. Moreover, the study established that service satisfaction is the most significant factor

that affects the overall success of the in-campus CBA system. Theoretically, this study contributes to the current body of literature by integrating the two well-known models and the technology readiness index (TRI 2.0) into a comprehensive framework. It examines service satisfaction as a mediating factor and considers goal expectancy and technology readiness as parallel moderating variables. The findings of this study have practical implications for managers and policymakers in higher education in Kano state and Nigeria to recognize the influences affecting the individual performance of CBA within institutions. Moreover, the model proposed by this study acts as a diagnostic instrument for institutional administrators and CBA managers to assess the impact of CBA within institutions.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Higher Education Institutions are undergoing a technological revolution shaking up traditional teaching and learning methods. The requirement of a physical teacher in the classroom for learning to occur is no longer necessary, as e-learning solutions have emerged. These solutions flexibly provide access to course materials and consistent delivery and are not bound by space or time limitations. Consequently, distance and online learning options are embraced by education providers as the future platform for teaching (Uppal et al., 2018).

Over the last few years, many higher education institutions, and examination organisations in developing countries have started using e-learning technologies to test students using computer-based exams (Nardi & Ranieri, 2019). This increased popularity is a result of the massification of educational institutions and the increase in class size, resulting in several institutions and organisations adopting electronic assessment tools. The switch to computer-based assessments from paper-pencil tests was also mainly due to the various benefits associated with the CBA, such as test security, reduced cost, time-saving, flexibility, report generation, decision-making analysis, improved reliability efficiency in scoring (Alyahya & Almutairi, 2019; Farzin & Dahlan, 2018; Sanni & Mohammad, 2015; Terzis & Economides, 2011b). The global reaction to the COVID-19 pandemic challenges recently necessitated some educational institutions to adopt computer-based assessment as part of the social distance strategy (Fuad & Rahim, 2020).

As e-learning continues to gain popularity, it is essential to recognize that its effectiveness cannot be taken for granted. Despite its potential to revolutionise education, challenges still need to be addressed. Misalignments between the use of technology in learning and established norms and practices within educational institutions are one of these challenges. This is particularly evident in areas such as assessments, where the efficacy of e-learning may not be fully realised due to these misalignments. It is essential to take a critical approach to the use of technology in education and to continually evaluate and adjust its implementation to ensure that it serves the best interests of learners and institutions alike (Mohammadyari & Singh, 2015).

Due to its 2013 adoption by the Joint Admission and Matriculation Board (JAMB) for the annual matriculation examination, the CBA system has gained widespread acceptance by Nigerian higher education institutions, even though some universities have adopted it earlier (Danladi & Dodo, 2019). Studies by Opie et al. (2016) and Fehintola (2018) identified several hurdles to CBA adoption in Nigeria, including inadequate electricity supply, inadequate telecommunications services, lack of ICT culture, economic factors, ICT policy and implementation, security, technical know-how, and human resources which affect students' performance in using the technology.

Despite these challenges, during the COVID-19 pandemic, more educational institutions in Nigeria adopted computer-based assessments for some examinations to curb the pandemic (Thomas & Amaechi, 2021). However, little is known about the student's performance in using the technology, which is the primary aim of technology introduction into education and is also a determinant of information system success (Sharabati et al., 2015). This study investigates the performance of computer-based

assessment systems among higher education students in Kano State, Nigeria. This is because studies on the effect of e-learning adoption on individual performance, particularly computer-based assessment in higher education environments, appear to be neglected and under-researched in the IS literature.

This chapter will introduce the study by explaining its highlighted background, problem statement, research questions, purpose and objectives, study significance, research scope, term definitions, and thesis organization.

1.2 Background of the Study

Due to the rapid growth of information systems (IS) and information and communication technologies (ICT), teaching and learning have been modernized globally. Computer technology and other multimedia aspects of modern education facilitate teaching and learning. Accordingly, this shift mandated the demand for electronic assessment systems (Fagbola et al., 2013), sometimes called computer-based test systems. Consequently, ICT in test development helped change the nature of what is being measured traditionally, improve test precision, and, more importantly, make test administration easier for students and institutions (Davey, 2005). From the underlying focus on professional certification examination for the IT business, CBA has developed into a generally acknowledged delivery model that was once overwhelmed by pen-on-paper examination. Osang (2014) indicates that about one million monthly tests are conveyed in high-stakes, innovative, technology-empowered examination centres worldwide.

In higher education institutions, assessment is an integral aspect of the educational process (Anwar et al., 2022). In order to be more efficient and tackle other issues, some traditional assessment practices have been replaced with electronic assessments since the advent of information and communication technology (ICT). In education, an assessment can be used to measure learning and provide feedback (formative assessment), or it can be used to grade students (summative assessment). Whatever the rationale for the assessment, learning without assessment is impossible, and vice versa. Furthermore, CBA provides an enormous opportunity for testing and assessment innovation (Vasileios Terzis & Economides, 2011b) and is used in many different contexts (educational and non-educational contexts, academic to professional circles).

Furthermore, CBAs are commonly employed in Open and Distance Learning institutions and some traditional face-to-face schools worldwide. As a result, students' assessment is transitioning from pen-and-paper assessments to paperless e-platforms and e-assessments. CBA tends to remove constraints and provide answers to many questions arising from traditional assessments/examinations (Osuji, 2012).

In addition, it is essential to recognise that initial acceptance of new technology is merely the first step toward overall success. The system's long-term viability and continued use accurately measure success. That is where the actual value of technology can be realised. According to research, initial acceptance is essential but insufficient to ensure success (Lin, 2019). To truly reap the benefits of an information system, it must be used consistently over time. This results in increased productivity, streamlined processes, and higher profits. However, in e-learning, the system's continued use does not guarantee its success unless it enhances learners' performance (Mohammadyari & Singh, 2015).

In the last five years, research trends in the field of Information Systems (IS) have emphasized the importance of measuring system usability concerning individual performance to determine system effectiveness (Tam et al., 2020; Abdullah AL Thnayan & Sami Mohammed Husain, 2021; Aldholay et al., 2020; Riandi et al., 2021). Different models, including the information system success model (DeLone & McLean, 2003), DOI Theory (Rogers, 1995), and Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003), have been employed to analyse the practical implementation of technology, rather than assessing its specific use. These trends have focused on factors influencing individual performance, including system and service quality, user satisfaction, and continuance intention.

Therefore, higher education institutions must develop ways to improve students' performance in using e-learning technology so that it is successfully accepted by all stakeholders (Papadakis, 2018). This success can be accomplished by understanding factors that impact students' performance in utilising the technology (Riandi et al., 2021). The term "individual performance" refers to students' improved quality of work while using a CBA system (Riandi et al., 2021). The improvements consist of various advantages, such as facilitating speedy task completion, empowering individuals to have greater control over their work, enhancing exam performance, reducing mistakes, and streamlining workplace productivity (Mohammadyari & Singh, 2015).

Several studies attempt to investigate the factors of the information system that cause the maximum individual performance of e-learning technologies through continuance intention (Mohammadyari & Singh, 2015; Yang and Lee, 2021; Al-Adwan et al., 2022; Aldholay et al., 2020). Most of these studies focus on e-learning technology in a general sense and do not take into account the various e-learning types,

whether through computer-based assessment (CBA), computer-supported collaborative learning (CSCL), or massive open online courses (MOOCs). These e-learning types differ in their objectives, features, and technical requirements. As a result, a particular e-learning individual performance model may not apply to all e-learning types because different factors determine their success. Thus, some studies propose an individual performance model designed for a particular e-learning type (Yang & Lee, 2021; Lin, 2012; Ayyoub et al., 2023).

There is a shortage of knowledge regarding the impact of CBAs on individual performance and the characteristics of CBAs that determine this impact. Consequently, evaluating the effectiveness of CBAs based on student performance is essential. However, most research has focused on examining students' initial acceptance or continued use of CBAs rather than their acceptance of use outcomes (Lin, 2019; Terzis & Economides, 2011b; Liu, Chen, & Lu, 2015; Lin & Lai, 2019; Alruwais et al., 2018; Nwagwu and Adebayo, 2016; Jimoh et al., 2015). However, the extent to which the user derives value from the platform is a crucial aspect in determining the platform's viability and success. Because previous researchers have focused more on CBA adoption, research on quality aspects of CBAs that may improve an individual's performance is in its early stages. As a result, by focusing on the Nigerian context, this study attempted to fill a research gap. This study aims to identify the most influential CBA characteristics on individual performance.

Therefore, this study investigates the students' perception of the e-learning technology of CBA, believing that enhanced individual performance of the e-learning technology in Kano State, Nigeria, higher education institutions will resolve most of the challenges in the education sector.

1.3 Problem Statement

In Nigeria, the demand for higher education has increased for several decades. Over 80% of the candidates seeking admission into Nigerian higher education institutions (HEIs) fail to gain entry due to limited access to HEI education (Chiaha et al., 2013). Due to the increasing number of students who need to be tested for exams, management, monitoring, and evaluation of learning present unprecedented challenges in modern times. There is a need to explore potential solutions, and technology could be a viable option (Nardi & Ranieri, 2019). Although e-learning seems to be a novel service delivery approach, its concept is gradually becoming eminent in Nigerian HEIs (Eze et al., 2020). Even though many Nigerian higher education institutions have launched initiatives to encourage the usage of IT for both virtual and in-person instruction, the introduction of IT-based innovations such as e-learning systems has wholly revolutionized the formerly traditional teaching and learning methods to a more modernized approach (Eze et al., 2020).

According to the World Population Review (2022), Nigeria has approximately 222 million people, and Kano state is one of the 36 states of the Federal Republic of Nigeria. Kano is the most populous state, with a population of 14.2 million (National Bureau of Statistics, 2020). Kano state has 15 higher education institutions, six universities, three polytechnics, and six colleges of education. Since the adoption of e-learning technology of computer-based assessment (CBA) for the annual matriculation examination into tertiary education in Nigeria by the Joint Admission and Matriculation Board (JAMB) in 2013, most of the higher education institutions in Kano state followed suit at different levels of adoption.

E-learning technologies are introduced to education in order to increase effectiveness and efficiency in teaching and learning processes (Mohammadyari & Singh, 2015). Students use e-learning technologies such as CBA system tools, hoping their participation will improve their assessment performance. However, in Nigeria, studies have shown that differences in students' CBA performances can be tied to their challenges when undertaking CBA (Faniran & Ajayi, 2018). Literature reported conditions and challenges that affect students' performance when utilising CBA in Nigeria. For instance, Waziri et al. (2019) and Danladi and Dodo (2019) identified system inadequacy, lack of technical support during the exam, and login-in and submission challenges as factors affecting students' performance in CBA in higher education in Nigeria. Equally, Fluck et al. (2017) and Azmi and Khoshaim (2021) reported complex user interfaces, question designs, fear, unfamiliarity with CBA technology, and lack of computer knowledge.

Similarly, Abubakar and Adebayo (2014) and Adepoju (2016) identified students' low ICT culture as one of the challenges. Likewise, Sanni and Mohammad (2015), Daramola (2015), and Adebanjo (2021) also mentioned poor ICT skills as some of the conditions that are believed to affect students' performance in using the CBA in Nigeria. The authors asserted that lacking these skills can present significant technological and human obstacles that impede CBA performance.

When implementing computer-based assessment (CBA), institutions also face several challenges, including developing a CBA policy that combines educational and practical goals, implementing effective methods to facilitate CBA, establishing a functional IT system to support CBA, and developing policies and protocols to ensure the credibility and legitimacy of CBA results (Appiah & van Tonder, 2018). Due to these challenges affecting students' performance while undertaking CBA,

Mohammadyari and Singh (2015) argued that e-learning technologies at higher education institutions could be less effective if unrelated to students' performance. Therefore, this study investigates the determinants of students' performance using e-learning technology of CBA systems in Kano state higher education institutions. It is believed that understanding individual performance using e-learning technologies such as CBA can be a long-term solution to many challenges in the Nigerian educational sector.

The intention to continuously use a specific e-learning technology does not represent an attitude toward the technology itself, but rather the acceptance that continued use will result in substantial outcomes such as career progress and improved performance (Wang et al., 2010). Students' intention to continuously use e-learning reflects their willingness to maintain dependence on it (Kapo et al., 2020). This dependence stems from their understanding that an e-learning system will improve their performance and fit well with their personal, school, or work lives (Mohammadyari & Singh, 2015). Several studies have helped reveal the general nature and areas of continuance use of e-learning impacts on individuals; they have produced numerous conflicting and inconclusive reports on the effects of e-learning acceptance. (e.g., Al-Adwan et al., 2022; Rokhman et al., 2022). Because of these reasons, this study investigates the relationship between students' continuance intention to use the CBA system and the individual performance of Kano State higher education students in Nigeria.

Nigeria's education sector has consistently received less funding than the 26% of the national budget that UNESCO recommended. For example, the education budget for 2021 hit a 10-year low, with only N742.5 billion allocated to the education sector out of a total budget of N13.08 trillion for the year. This allocation represents a

meagre 5.6%, the lowest since 2011(Tyesi, 2022). Similarly, the United Nations Children's Fund (UNICEF) has contended that Nigeria's education budget for 2022 should have been N1.14 trillion, or 8.4%, instead of 5.4% of the country's overall annual budget (Tyesi, 2022). Despite the Federal Government of Nigeria's pledge to enhance education, a review of budget allocations in other African countries indicates that the Nigerian government was not dedicating enough resources to the sector (Oyedeji, 2016). Hence, these call for collaboration between sectors of the Nigerian economy and tertiary educational institutions to reform and assist in providing some educational infrastructures and services, including e-learning technology services (Asiyai, 2013).

Consequently, some higher education institutions that adopted e-learning technologies like CBA contracted CBA services to commercial firms, such as the Nigerian Electronic Testing Company (ETC) and other private organisations, individuals, and partnering organisations as their service providers. For example, the ETC had entered into a public-private partnership with some institutions (Adebayo, Abdulhamid, & Fluck, 2013). In 2010, the Federal University of Technology Minna agreed with the company to build, manage and provide CBA for ten years, during which some university staff would be prepared to take care of the centre after their departure (Adebayo et al., 2013).

Equally, an accurate assessment of the quality of e-learning is crucial for the effective management of e-learning delivery (Vairamuthu & Anouncia, 2016). This assessment enables e-learning providers to tailor their products to meet the specific needs of learners (Uppal et al., 2017). Service satisfaction is a crucial factor that needs to be considered in this study, as it focuses on evaluating the CBA users' satisfaction with the services provided by service providers. Therefore, it is essential to assess

users' satisfaction with the e-learning technology providers' services following their interaction with the system. This is because prior research has demonstrated that user satisfaction with an information system can affect individual performance, as evidenced by studies conducted by Li (2023), Feng et al. (2023), Yuliansyah et al. (2018), Abdullah AL Thnayan and Sami Mohammed Husain (2021), Aldholay et al. (2020) and Ayyoub et al. (2023).

1.4 Research Questions

This study has formulated the subsequent research questions built on the preceding arguments. The main research question is: What variables influence students' performance in the CBA system in Kano, Nigeria, higher education institutions? The following are the specific research questions:

(1) How does the Computer-Based Assessment (CBA) system affect the individual performance of higher education student in Kano State, Nigeria?

(2) What is the impact of continuance intention and overall satisfaction with Computer-Based Assessment (CBA) on student performance, considering variations in goal expectancy and technology readiness levels?

(3) How does service satisfaction influence the relationship between CBA quality factors and overall satisfaction?

1.5 Research Objectives

After identifying problems in previous sections, the study established research objectives to achieve its goal. The primary aim is to comprehensively understand how combining certain variables can explain Kano state higher education students' performance in the CBA system. The specific objectives are:

(1) To determine the impact of the CBA system on the individual performance of higher education student in Kano State, Nigeria.

(2) To investigate the influence of continuance intention and overall satisfaction with CBA on individual performance among students with different levels of goal expectancy and technology readiness.

(3) To examine the mediating role of service satisfaction between quality factors and overall satisfaction in influencing a successful CBA system.

1.6 Significance of the Study

This study presents some significant contributions expected to bridge the identified gaps. The contributions are intended to be theoretical and practical.

1.6.1 Theoretical Significance

This study adds novel information to the expanding studies examining how e-learning affects individual performance. Few studies have integrated the information system success model (ISSM), expectation confirmation model (ECM), and technology readiness index (TRI 2.0) to investigate individual performance. This study further integrates goal expectancy, perceived soundness of assessment policy, and perceived trust into the model to examine the students' personal performance using the CBA system.

Service quality evaluation, which is service satisfaction in this study's model, is less considered in e-learning literature (Vairamuthu & Anouncia, 2016), mainly when some e-learning services are outsourced or provided by outsourcing or collaborating partners. This study empirically validates the research model to examine the mediating effect of service satisfaction. Furthermore, the study provides empirical evidence for combining personality traits and extrinsic factors to understand the variables affecting user performance using the CBA system. The perceived usefulness, perceived trust, and perceived soundness of assessment policy will be used as direct antecedents of continuance intention, subsequently affecting individual performance.

Also, some studies have investigated the correlation between continuance use intention and individual performance (Mohammadyari & Singh, 2015; Al-Adwan et al., 2022; Lin, 2012; Rokhman et al., 2022). This study takes a step further by investigating the parallel moderating effects of the two personality traits of goal expectancy and technology readiness on the relationship between continuance use intention and individual performance. Moreover, this study will make a significant theoretical contribution by critically examining the role of cost-effectiveness, a marketing construct, and questions' content of CBA as context-specific factors (Economides & Roupas, 2007) in achieving CBA satisfaction, which is ignored largely by previous research.

Additionally, this study is one of the few that has explored students' perceptions of their performance using a CBA system in Nigerian higher education. As a result, the research has the potential to contribute to filling the gaps in e-learning research in the Nigerian context.

1.6.2 Practical Significance

Exploring the factors that impact students' performance using e-learning systems is crucial to optimize their effectiveness in higher education (Sharma et al., 2014). By examining the perceptions of learners, such as their attitudes toward CBA systems, the top management can better understand which factors are critical in influencing students' performance in using the system. Therefore, this study has practical implications for Nigeria's federal and state governments, education administrators, higher education management, and policymakers on education. This study may enhance the knowledge and understanding of e-learning in Nigeria by providing recent and relevant information.

Furthermore, this study is significant to Nigeria, as there are few empirical studies on the students' perceptions and performance in using e-learning, specifically the CBA system, in Nigerian higher education. The study examines the factors that affect students' performance using e-learning in general and the CBA system in particular. The insights provided regarding the influence of each determinant factor on students' performance and behaviour could inform the formulation of government policies and contribute to the success of e-learning systems. Additionally, this knowledge could enable the government to develop strategies to accommodate more students who wish to pursue higher education in Nigeria. However, it may be unable to do so due to the limited availability of slots in the current conventional educational system.

1.7 Scope of the Study

The scope of the study refers to its geographical coverage, context, and variables. The study is conducted in higher education institutions in the core northern

state of Kano, Nigeria, that have established CBA systems and were used to assess undergraduate students. Three higher education institutions with an established CBA system used for more than five years were included, while those without an established CBA system were excluded. The study focuses only on undergraduate students, as preliminary investigations suggest that the CBA systems are primarily intended for their assessment. Additionally, the research only collected data on one e-learning technology, the CBA system, because the study's goal was to collect empirical data on student performance using this technology. The study only examines variables directly related to the concept under investigation, and irrelevant variables were excluded. Finally, the study focuses solely on end-users (students) and not service providers, based on the research objective, research question, and hypothesised relationships targeted for investigation.

1.8 Operational Definitions of Terms

Overall satisfaction — refers to the user's views of the extent to which their needs, goals, and desires have been fully met; it refers to the user's overall view of a system (Dang et al., 2016).

Service satisfaction — is the degree of favourableness with respect to the services provided (F. Xu & Du, 2018)

Goal Expectancy — The variable measures users' belief that they are prepared to continue to use the CBA system. It represents how users felt before and during their CBA, which includes student's self-confidence and goal orientation concerning the use of a CBA (Vasileios Terzis & Economides, 2011b)

Cost-effectiveness —refers to what users conclude when evaluating the usefulness of a system against its costs (Kim, Yoon, & Han, 2016).

Questions content — is the clarity, understandability, and relevance of the CBA questions to the course (Vasileios Terzis & Economides, 2011b).

System Quality — these are the desirable characteristics and features of the CBA system (Holsapple & Lee-Post, 2006).

Service Quality — these are the desirable characteristics of user-service staff interactions (Holsapple & Lee-Post, 2006).

Perceived Soundness of the Assessment Policy — The perceived soundness of the assessment policy mainly measures students' perception of the soundness of the assessment rules and regulations (Liu et al., 2015).

Perceived Usefulness— is the extent to which a user believes that continuance use of the system will enhance his/her performance (Vasileios Terzis & Economides, 2011b).

Perceived Trust— The perceived Trust (PT) of a system represents users' perceptions about the reliability and trustworthiness of the system (Liu et al., 2015).

Technology readiness — Technology readiness represents users' tendency to embrace and use new technologies to achieve their goals (either at home or school) (Parasuraman & Colby, 2015).

Continuance Intention ---- is the user's intention to continue using a system based on past experience (Bhattacherjee, 2001).

Individual performance ----- is the user's efficiency and effectiveness at performing tasks with an information system (Adnan et al., 2017b).

1.9 The Organisation of the Thesis

The present study is structured into six chapters as outlined:

Chapter 1 outlines the study's background, problem statement, research questions and objectives, significance, scope, and operational definitions of key terms.

Chapter 2 of the study offers an overview of the existing literature on e-learning technology and computer-based assessment systems, along with related variables pertinent to the research. The chapter also examines previous studies relevant to the current study in detail. In addition, the underlying theories and models related to the research are analysed and evaluated concerning the investigated variables. Furthermore, the chapter establishes a connection to the context of the study.

Chapter 3 reviews related works, discussing and explaining the relationships and associations between the study variables that support the development of the theoretical framework and hypotheses.

Chapter 4 outlines the methods and procedures used to achieve the research goal. The chapter focuses on sample design, sampling strategy, study variables, and measures. The research also focuses on the instrument's reliability and validity, as well as the pre-test and pilot study.

Chapter 5 explains data analysis, descriptive analysis, and hypothesis testing. This chapter includes the profiles of the respondents, as well as correlation and regression analysis.

Chapter 6 analyses the findings of the study in terms of hypotheses testing results, result implications, study limitations, and recommendations for further research.

Chapter 7 summarises and conclude the study by providing the limitations, and recommendations for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The primary purpose of this chapter is to examine the literature related to the study's objectives. In addition to providing an overview of the general concept of e-learning technology, including its different types and forms, the chapter also explores the factors that can impact individual e-learning performance. The underlying theories that are relevant to the study are also discussed. Furthermore, the chapter delves into the variables and constructs related to the research.

2.2 E-learning System Concept

The continuous progress of information and communication technology (ICT) has presented higher education institutions (HEIs) with opportunities to enhance their teaching and research. These institutions rely on quick access to information to become proactive, and technological advancements allow them to do so (Eze et al., 2020). According to Aldholay et al. (2018), the prevalence and availability of devices like laptops, smartphones, and tablets have increased the emphasis on innovation and technology.

An e-learning system is a web-based communication platform that allows learners to access various learning tools such as discussion boards, assessments, content repositories, and document-sharing systems from anywhere and at any time (Mohammadyari & Singh, 2015). In other words, e-learning has become a contemporary educational approach that utilizes information technology to transmit knowledge and information for training and education purposes (Al-Adwan et al.,

2022). E-learning is increasingly essential in the education process as it provides greater accessibility to learning. With e-learning, individuals can study at their convenience and receive coaching and support anytime, potentially around the clock. This enables learners to acquire a classroom-like experience with expert tutors from anywhere worldwide (Mohammadyari & Singh, 2015).

In Nigeria, public and private higher education institutions have adopted e-learning and implemented various web-based platforms for their students (Eze et al., 2020). This adoption is promoted due to many advantages, including expanded geographic reach, ease of access, comfort and adaptability, high-quality learning materials, and cheaper learning expenses (Mohammadyari & Singh, 2015). Therefore, e-learning systems are a significant trend in higher education and are proliferating.

Regrettably, studies have revealed low utilization of e-learning systems in Nigerian higher education. This situation is a cause for serious concern regarding e-learning adoption in Nigerian tertiary institutions. It is attributed mainly to institutional and motivational factors that affect students, affecting their performance in using e-learning technology (Thomas & Amaechi, 2021). The Nigerian higher education sector is confronted with significant challenges, such as a rapid increase in student population, limited resources, low-quality education delivery, and inefficiency in public administration (Eze et al., 2020). These challenges highlight the urgent need for a plan to address them. Simultaneously, e-learning is regarded as the future of education and has the potential to provide a practical solution to these issues in Nigeria.

According to Lin (2019), computer-based assessment (CBA), computer-supported collaborative learning (CSCL), and massive open online courses (MOOCs) are three types of e-learning systems. Similarly, each of these types of e-learning has

different features, goals, and technical requirements. As a result, various factors determine the success of varying e-learning types, and a single e-learning performance model may be unable to generalise to all e-learning types (Lin, 2019).

2.2.1 Computer-Based Assessment System (CBA)

Computer-based assessment (CBA), defined by Guàrdia et al. (2017), is the application of information and communication technologies to facilitate the assessment process, from assignment production to assignment review and statistical analysis. Similarly, Ivanova et al. (2018) defined it as "the end-to-end electronic assessment processes where ICT is used to present assessment activity and record responses. This includes the end-to-end assessment process from the perspective of learners, tutors, learning establishments, awarding bodies and regulators, and the general public." CBA is now required for successful online learning and teaching and is organised using various technological solutions. CBA can be performed using a variety of devices, including standard desktop computers and laptop computers, with portable devices such as smartphones, iPads, or electronic gaming devices (Crisp, 2011). Electronic assessments have tremendously impacted educational development and are now widely used in higher education institutions worldwide.

Computer-based assessment (CBA), as an e-learning system, is sometimes included as a module part of a learning management system like *Moodle, the Blackboard*, or provided using a dedicated system like *Test Pilot, Questionmark Perception, A-Tutor, or Maple T.A* (Mobarhan et al., 2015; Terzis & Economides, 2011b; Lin, 2019; Warner, 2017; Kuikka et al., 2014). According to Hamsatu, Yusufu, and Mohammed (2016), CBA has been introduced in developed countries since the 1970s. Nigerian higher education institutions have been using it for the past ten years.

However, it became famous when adopted by the higher education matriculation examination board in 2013.

The CBA system manages all assessment-related purposes and documents in an organisation. Such a system would drastically reduce the cost of conducting an assessment session. It will be a time-saving tool for the organisation and the participants (Alyahya & Almutairi, 2019; Escudier, Newton, Cox, Reynolds, & Odell, 2011; Sanni & Mohammad, 2015). It will enhance test security and benefits the organisation by preparing fast feedback and generating reports to rationalise the decision-making process for item analysis and distance learning (Terzis & Economides, 2011; Farzin & Dahlan, 2018; Parshall, Spray, Kalohn, & Davey, 2002). Furthermore, student registration and retention are increased due to CBA, which creates a potential for additional courses, broadening the institutions' financial horizon (Masouras & Vate-U-Lan, 2016).

Previous research categorized CBA into formative and summative assessments (Vasileios Terzis & Economides, 2011b). Summative assessments help determine whether or not students have attained their goals. On the other hand, formative assessments offer directive feedback to aid students in achieving their learning objectives (Terzis & Economides, 2011b). Additionally, students are evaluated utilizing multiple-choice questions (MCQ), multiple responses, hot spots, matching, rating, drag-and-drop, multiple steps, and open-ended questions (Obeidallah et al., 2015).

Fundamentally, two methods exist for delivering CBA to students: web-based delivery format and download delivery format. In a web-based delivery approach, a student will access the assessment tasks through the internet (online assessment) so

that the assessment can be conducted at any time, provided an internet connection exists (Appiah & van Tonder, 2018). On the other hand, in the download delivery approach, the assessment can be delivered anytime, anywhere, provided computer systems exist (Appiah & van Tonder, 2018). According to Crisp (2011), schools or organisations can upload their questions to students anytime and anywhere, provided they can access the server. Schools and businesses can also employ facilities incorporated into an e-learning system such as Moodle or Blackboard or a standalone assessment system such as Test Pilot, Questionmark Perception, A-Tutor, or Maple (Osuji, 2012). Notably, schools can customise their CBA platform to their specific requirements. Moodle is an open-source platform that may be tailored to meet a particular institution or school's policies, procedures, and regulations.

Alabi, Issa, and Oyekunle (2012) identified two types of CBA in classification: (i) Linear Test - A full-length test in which the computer selects different questions for individuals without considering their performance. (ii) Adaptive Test - The computer selects questions based on the performance levels of the individuals. These questions cover a wide range of topics and levels of difficulty.

Most of the published works in CBA come from developed countries where CBA has recorded considerable success (Terzis & Economides, 2011; Kalogeropoulos, Tzigounakis, Pavlatou, & Boudouvis, 2013; Okada et al., 2019). Moreover, most of the researches in CBA are concerned to figure out which factors affect the students' initial acceptance and adoption of CBA (Terzis & Economides, 2011b; Liu, Chen, & Lu, 2015; Lin & Lai, 2019; Alruwais et al., 2018), or studies that compare students' academic performance on CBA to paper-based assessment (Nardi & Ranieri, 2019; Alyahya & Almutairi, 2019; Escudier et al., 2011; Cassady & Gridley, 2005; Sapriati & Zuhairi, 2010; Jeong, 2014; Garas & Hassan, 2018; Ram,

Bowles, Yan, & Joo, 2018) or studies that dwelled on challenges of CBA introduction and uptake (Acosta-Gonzaga & Gordillo-Mejia, 2015; Kuikka et al., 2014; Fehintola, 2018) and others are concerned with the systems design and security (Nguyen, Rienties, Toetenel, Ferguson, & Whitelock, 2017; Obeidallah et al., 2015 ;Adebayo, Saliu, & Shafi'i, 2011; Apampa, Wills, & Argles, 2009; Al-Saleem & Ullah, 2014), while others researched on students' perception of CBA technology (Carmen Sarceda-Gorgoso, Caldeiro-Pedreira, & Guevara-Betancourt, 2019; Sanni & Mohammad, 2015; Sorensen, 2013; Durojaye, 2016; Bloom, Rich, Olson, & Adams, 2018; Terzis & Economides, 2011a; Attia, 2014; Faniran & Ajayi, 2018; Chen, 2019), and some concentrated on quality evaluation of CBA systems (Economides, 2005).

2.2.2 Massive Open Online Courses (MOOCs)

A MOOC is an e-learning system where experts provide study material for interested individuals, known as students, who connect through social networking (Khurana et al., 2019; Liyanagunawardena et al., 2013). The standout characteristic of MOOCs is their convenience and broad dissemination, making them a valuable resource for enhancing education quality at a low cost and with high efficiency (Carannante et al., 2021; Yang & Lee, 2021; Khurana et al., 2019). Participation is voluntary, and a MOOC's collaborative space can span multiple platforms and technologies. For instance, MOOC participants can use platforms such as blogs and microblogs like Twitter to discuss various aspects of the course (Liyanagunawardena et al., 2013). The first MOOC was "Connectivism and Connective Knowledge," an online course facilitated by George Siemens and Stephen Downes and offered by the University of Manitoba's Learning Technologies Centre and Extended Education