Digital Divide and its Impact on the Performance of Students taking high-stake Computer-based University Entrance Examination in Nigeria

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Declaration of Authenticity and Author's Rights

This thesis is the result of the author's original research. It has been composed by the author and has not been previously submitted for examination, which has led to the award of a degree.

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In humble gratitude, I dedicate this thesis to Allah, the source of all wisdom and guidance, whose infinite mercy has illuminated my academic path.

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Abstract

Using computers for assessment has various advantages for both educators and test takers. However, the literature has no consensus on the impact of ICT individual differences on CBT performance and experience. As a result, additional evidence is required, particularly for students from digitally divided regions. In Nigeria, the Unified tertiary matriculation Examination (UTME), a large-scale university admission examination, was fully computerised in 2015. However, the learning mode in most high schools does not align with the computer-based assessment method adopted for the high-stakes examination, resulting in a potential disadvantage for some applicants. This study investigated ICT-related individual differences (computer familiarity and computer-based tests anxiety and attitudes) among secondary school students taking large-scale high-stake CBT university entrance examinations in Nigeria and its effects on their performance on the test. In order to achieve this aim, we conducted a review of relevant literature, conducted two quantitative surveys and a qualitative enquiry. The quantitative study's findings revealed significant variations in the access and use of computers among students taking UTME, especially when comparing students in publicly owned and privately owned schools. Furthermore, computer familiarity positively correlates with students' performance in UTME. However, computer attitude and anxiety before and after UTME were moderate and had no significant relationship with test performance. The qualitative study explores the students' experiences in more depth and gains more insights into the factors contributing to their attitudes and anxiety. This thesis thoroughly describes the procedure above and its results. This study underlines the necessity of addressing the digital gap in education in Nigeria by demonstrating inequalities in access to technology and infrastructure among students taking high-stake computerised examinations in Nigeria and its impact on their performance.

CHAPTER 1

INTRODUCTION

1.1 Background to the study

The digital divide is a critical issue in information science, where scholars have explored the impact on individuals, communities, and society (Van Dijk, 2006; Rye, 2008; Cruz-Jesus *et al.*, 2016a). The digital divide involves the difference between individuals, households, businesses and geographical areas of varying socio-economic backgrounds concerning the availability/accessibility of information technology infrastructures such as computers, the internet, and others (OECD, 2016; Okunola, Rowley and Johnson, 2017a; Scheerder, van Deursen and van Dijk, 2017). Technological underdevelopment is prominent in socio-economically disadvantaged areas (Thompson and Walsham, 2010; Okunola, Rowley and Johnson, 2017a). Usually, people from a higher socio-economical background in urban settings have higher access to technology, technical knowledge and competency (Azubuike, Adegboye and Quadri, 2021; Franken *et al.*, 2022).

Nonetheless, CBT has gained popularity in the past few decades (Helfaya, 2019). Its adoption is spread across countries and continues to gain recognition in its use for standardised examinations. The computerised test is used as a prerequisite for various human activities, including migration eligibility tests, driver's licenses, job applications, language testing, and entrance examinations for post-secondary education (Hosseini *et al.*, 2014). The adoption of CBT systems has brought about several benefits: flexibility of test scheduling and location, access to an extensive repository of test questions, more efficient result processing and storage, better time management, reduction in malpractices, and immediacy of scoring and reporting (Naus, Philipp and Samsi, 2009; Terzis and Anastasios A Economides, 2011; Terzis, Moridis and Economides, 2013; Stavros A. Nikou and Economides, 2016; Prisacari and Danielson, 2017a). Hence, CBT transforms and improves educational institutions' learning, assessment, and curricula (Chua and Don, 2013). The digital divide has the potential to

result in differences in student performance on these assessments (Bugbee, 1996; Mcdonald, 2002). Studies have found that digitally disadvantaged students may struggle to navigate CBT, leading to lower test scores (Goldberg and Pedulla, 2002; Zou and Chen, 2016; Shirzad and Shirzad, 2017).

In Nigeria, The Joint Admission and Matriculation Board (JAMB) adopted the exclusive use of the CBT to conduct the Unified Tertiary Matriculation Examination (UTME) in 2015. UTME is a high-stake tertiary institution pre-requisite in Nigeria conducted yearly with no direct alternatives. Even though CBT has several advantages mentioned above, the exclusive adoption of CBT for such high-stake mandatory examinations may pose a challenge to some students in Nigeria—especially students with limited or no access to digital technology. Unlike most developed countries, Nigeria is a grossly socio-economically unbalanced society and, by extension, a digitally divided country (Okunola, Rowley and Johnson, 2017a). Consequently, JAMB's exclusive adoption of CBT for UTME may pose a challenge to students from disadvantaged digital technology backgrounds.

Furthermore, since the adoption of CBT by JAMB, there has been constant uproar about the conduct and appropriateness of the examination. These include the agitation about the authenticity of students' test scores (Aku, 2021; Magana, 2021; Punch, 2021). Students suggest that their performance in the examination does not accurately represent their understanding and proficiency in the courses taken (e.g. (Agency Report, 2019b; Magana, 2021)). Hence, constant allegations are made on the comparability of scores of the CBT system with the previously utilised paper-based test (PBT) system. Meanwhile, the international guideline for replacing PBT with CBT requires that equivalent test scores be established for the new CBT and the previously utilised conventional method of examination (International Test Commission, 2004).

1.2 Problem Statement

In Nigeria, most high schools' learning mode does not align with the computer-based assessment method adopted for the high-stakes UTME examination, resulting in a potential disadvantage for some applicants. Many high schools still lack computer-assisted learning, and most students do not have ready access to computers, especially those in rural areas (Olanrewaju *et al.*, 2021). As a result, many UTME examinees have little or no exposure to computers prior to the exam, which could put them at a disadvantage. Moreover, there have been ongoing concerns about the appropriateness and conduct of UTME. While some researchers have investigated the equivalence of test scores between computer-based and paper-and-pencil test administration modes, there is a need for further research on the impact of ICT-related individual differences on test performance, particularly in a digitally divided society like Nigeria.

This study aims to investigate the effects of ICT-related individual differences on the performance of secondary school students taking the high-stakes CBT university entrance examinations in Nigeria. Computer experience, anxiety, and attitude are key ICT-related factors that have been shown to affect students' performance in CBT (Mcdonald, 2002). However, most existing studies on the topic have been conducted on users from well-developed societies with similar levels of exposure and prior computer experience. Therefore, this research will investigate ICT-related individual differences among secondary school students taking large-scale high-stake CBT university entrance examinations in Nigeria and its effects on their performance on the test. The findings of this study could inform the development of effective interventions to mitigate the effects of ICT-related differences on CBT performance and promote equitable access to high-quality education in Nigeria.

1.3 Thesis Aims and Objectives

This study aimed to investigate ICT-related individual differences among secondary school students taking large-scale high-stake CBT university entrance examinations in Nigeria and its effects on their performance on the test. To achieve the aim of this research, this study has the following research objectives:

1. To assess how computer familiarity, CBT anxiety and attitude vary across Nigerian secondary school students.
2. To find the relationship between the computer familiarity of the examinee and test performance in a high-stake CBT.
3. To identify the examinee's CBT attitude and anxiety before and after UTME and the relationships with test performance in a high-stake CBT.
4. To learn about students' attitudes and anxieties towards the CBT version of the UTME exam?

1.5 Research Hypotheses

The following are the research hypotheses:

1. **$H_0$1:** There is no significant difference in UTME examinees' computer familiarity/experience based on their school type and location.
2. **$H_0$2:** There is no significant relationship between aspects of UTME examinees' computer familiarity/experience and their test scores.
3. **$H_0$3:** There is no significant difference in UTME examinees' anxiety about PBT and CBT based on their school type and location.
4. **$H_0$4:** There is no significant relationship between test takers' anxiety about CBT before and after UTME and their test scores.
5. **$H_0$5:** There is no significant difference in UTME examinees' attitudes to PBT and CBT based on their school type and location.
6. **$H_0$6:** There is no significant relationship between test takers' attitudes to CBT before and after UTME and their test scores.

1.4 Research Question

The following are the research questions of this study:

1. Are UTME examinees' computer familiarity/experience differences based on their school type (public versus private) and location (urban versus rural)?
2. What is the relationship between aspects of computer familiarity/experience of UTME examinee and their test score?
3. Are there differences among UTME examinees' anxiety about PBT and CBT (before and after UTME) based on their school type (public versus private) and location (urban versus rural)?
4. Does the test takers' anxiety about CBT before and after UTME predict their score in UTME?
5. Are there differences among UTME examinees' attitudes to PBT and CBT (before and after UTME) based on their school type (public versus private) and location (urban versus rural)?
6. Does test takers' attitude to CBT before and after UTME predict their score in UTME?
7. What can we learn about students' attitudes and anxieties towards the CBT version of the UTME?

1.6 Scope of the study

Osun state has been selected based on convenience for data collection in the available time for this research. Osun state is a reasonably secure state with minimal terrorist activities; hence, the state was selected to minimise the effects of challenges related to terrorism interfering with data collection. Additionally, terrorist activities may exacerbate the digital divide and the quality of education students receive. Data was collected from final-year students who registered for UTME in 20 secondary schools in the state: five public and five private secondary schools in the state capital (urban) and five public and five private secondary schools outside the state capital (rural). This study used both quantitative and qualitative investigation to provide in-depth insights into the variation of ICT-related individual differences in Nigerian secondary schools and the effect on students' performance in UTME.

1.7 Significance of the Study

This study contributes to the theoretical knowledge in information science by providing new insights into the digital divide and CBT. It underscores the need to address the digital education gap, showing inequalities in access to technology and infrastructure based on school type and location. The study strengthens the understanding of the relationship between the digital divide and academic achievement, demonstrating its impact on students' performance in CBTs. It also sheds light on the complex relationship between the digital divide and technological attitudes, revealing the causes of students' unfavourable attitudes and anxiety regarding CBTs. Overall, the study provides insights into the contextual elements that contribute to the digital divide and emphasises the need for policymakers to prioritise investments in technology and infrastructure to bridge the digital divide gap among students and improve educational outcomes in Nigeria and other similar contexts.

1.8 Operational Definition

Computer: standard consumer personal desktop computer with Microsoft Windows.

Computer-based Test (CBT): Assessment done on standard consumer personal desktop computer with Microsoft Windows.

Tradition Test/Paper-based Test: Assessment done with paper and pen/pencil.

CHAPTER 2

BACKGROUND

2.1 Introduction

Around the world, accessibility and equality to higher education are essential to the education agenda (Prakhov and Yudkevich, 2019). Higher education institutions are strategic actors supporting sustainable development through teaching, research, and social activities (Rokicki *et al.*, 2020). Given the importance of education, it is paramount that access to education, especially higher education, is fair and equal for all. Numerous students worldwide, usually students who have completed their secondary education, apply for admission into various tertiary education establishments, such as universities, technical schools, colleges and polytechnics. The number of applicants usually outnumbers the capacity available in tertiary institutions. Therefore, there is very steep competition among people seeking admission into various tertiary institutions. Consequently, tertiary institutions explore ways to shortlist applicants to their institution and select the best among them who have better chances of succeeding in their course of study.

The admission process varies from one country to another. It is not uncommon that admission requirements can vary from one institution to another. However, some government agencies and independent organisations offer standardised examinations or school certifications that tertiary admission seekers can use to show their academic competence and facilitate admission processes in most countries. A standardised exam measures educational processes' knowledge and/or skills (Smith Glasgow, Dreher and Schreiber, 2019). Examples of standardised examination is the Unified Tertiary Matriculation Examination (UTME) and Senior Secondary Certificate Examination (SSCE)/ General Certificate Examination (GCE) conducted by the West Africa Examination Council (WAEC) and Nigeria Examinations Council (NECO) in Nigeria; Scholastic Assessment Test (SAT) in the USA; General Certificate of Secondary Education (GCSE) in England and School Qualification Certificate (SQC) in Scotland. Student performance in standardised examinations is used to assess candidates'

readiness for tertiary studies and courses of study in the institution. Hence, the better a student's performance, the higher the chances of such students securing admission to the desired school and course of studies.

2.2 Nigeria Tertiary Education Admission Requirement

Standardised examination requirements for tertiary education admission vary from country to country. Some countries use a centralised system, where admission is majorly dependent on a single exam. The results are used for admission processing in the university of choice. However, countries like Nigeria have multi-faceted examinations for deducing the tertiary education potential of applicants. To be qualified for admission into various Nigerian institutions, tertiary admission seekers must take at least two standardised examinations (in most cases) to gain admission into tertiary education, a centralised exam- UTME and at least one of SSCE, GCE or their equivalent. In addition, most government-owned institutions require students to take an additional exam –post-UTME- to further assess candidates' competencies. However, an exam that seems to be general to all admission seekers is UTME and is only conducted by JAMB once a year, and there is no direct equivalent. Approximately 2 million Nigerian tertiary institution admission seekers take UTME yearly. The two major entrance examinations into Nigerian tertiary institutions are discussed below.

2.2.1 Senior School Certificate Examination (SSCE)

SSCE is conducted by two central bodies, the West African body (WAEC) and the National body (NECO). WAEC was founded in 1952. WAEC was established to determine the examination requirement of five (5) English-speaking West African countries (Nigeria, Ghana, Sierra Leone, Liberia, and The Gambia). The institution is tasked with organising and conducting examinations in the five countries and issuing a certificate to exam takers that is equivalent to their international counterparts (WAEC, 2020). Similarly, NECO was established in 1999 and is responsible for conducting Nigerian National examinations: National Common Entrance Examination, Basic Education Certificate Examination and SSCE, a requirement for admission into government-owned primary schools, government-owned secondary schools, and

tertiary institutions nationwide, respectively. For both NECO and WAEC, their structure, pattern, and syllabus are very similar. Moreover, both bodies conduct examinations twice a year; May/June for school-registered candidates and November/December for independent candidates. WAEC and NECO examinations are very similar in examination structure, subjects available for registration, examination registration and examination conduct. Therefore, only detailed information about WAEC is given to avoid repetition.

2.2.1.1 Senior School Certificate Examination Requirements

Candidates who are registered by school for SSCE are expected to be in their final year in senior secondary school (SS 3) in a recognised school. On the other hand, for a private candidate (not affiliated with any recognised secondary school) to be qualified for registration, the candidate can be any of (i) have attempted SSCE in the previous year, (ii) someone who has attempted GCE and have at least three credits and (iii) someone who passes grade 2 examination (WAEC, 2020).

Candidates can register for a minimum of 8 courses and a maximum of 9 courses. Mathematics and English language are compulsory subjects for all SSCE candidates. Additional courses are selected based on the desired discipline of the candidate. For instance, students intending to study applied sciences courses are expected to take Physics, Chemistry/Biology and Agricultural sciences. On the other hand, art and literary studies enthusiasts will take Literature in English, History, and Government. Lastly, candidates interested in pursuing social science courses would take commerce, accounting and economics principles. Also, students must take three additional courses not already offered as a core course stated above.

The examination is a paper-pencil test (PPT) usually offered over a couple of weeks. The examination questions usually include multiple-choice questions, essay questions and practical examinations. Each subject taken in the examination is graded on a scale of A to F. A candidate must obtain at least five credits in relevant courses, including English and Mathematics, to pass the examination. SSCE is used in

combination with UTME in most cases to process admission into various tertiary institutions.

2.2.2 Unified Tertiary Matriculation Examination (UTME)

UTME, an examination organised by JAMB, started in 1978 in Nigeria. It was first used as a matriculation exam for only degree-awarding tertiary institutions. By the year 1998, other tertiary institutions, such as colleges of education, have adopted the exam as a matriculation requirement. In the year 2009, innovative enterprises followed suit. Approximately 2 million tertiary admission candidates register for UTME yearly(Agency Report, 2019a; Umeh, 2022).

Students undertaking UTME are expected to have completed or are about to complete secondary school education, technical colleges, or equivalent. Candidates should be at least 16 years old by the 1st of October of the year exam is set to qualify to write the exam. The examination syllabus is provided by JAMB, highlighting the subject and topics covered in the exam. The exam only takes place once a year, spreading over two weeks. Therefore, candidates have only one chance to take the exam in a year.

At the time of registration, students can choose the desired University, Polytechnic, or College of Education. Besides, candidates are to choose four (4) of the 22 subjects available in the UTME subject index. English is a compulsory subject for all examination takers'; hence, students can choose a combination of three other subjects, usually based on the desired course of studies. Prior to the UTME exam, JAMB usually releases an updated subject combination list for the desired course. Therefore, students are expected to carefully study the subject combination of the desired course of study and register accordingly. For example, a candidate who wants to study Medicine is expected to take a combination of English, Biology, Chemistry, and Physics. On the other hand, a candidate that wants to study Civil Engineering is expected to take a combination of English, Physics, Chemistry, and Mathematics. A mistake in the subject combination taken could deny students the opportunity to gain admission into the desired course even when the student gets a very high UTME score.

2.2.2.1 UTME Requirement for Tertiary Institution Admission

Nigeria Tertiary institutions' UTME requirements vary across Nigerian universities. Top-ranking Universities in Nigeria, such as the University of Ibadan and the University of Ilorin, require students to have a high score and be among the top percentile. Similarly, highly revered courses such as Medicine among applied science disciplines, Law among art disciplines, and Accounting among social science disciplines usually require the highest UTME scores amongst counterparts. As earlier stated, students are required to choose the desired course and university of study at the point of registration. Suppose a student's score is lower than the minimum score required by the desired institution for the course of study. In that case, candidates may apply for a course change or institution that suits students' grades. However, a change of institution and/or course of studies usually comes at a fee that the candidate must pay to JAMB.

2.2.2.2 UTME Structure

Prior to 2013, JAMB conducted UTME using PBT; CBT was only introduced as an optional test mode in 2013. During the partial adoption of CBT in 2013 and 2014, candidates can choose to write their exams exclusively using the PBT, CBT or a combination of both (students read exam questions on-screen and supply answers on paper). In 2015, JAMB switched totally to computerised tests. The switch was because of the alarming rate of examination malpractices and to promote computer-administered assessment in the country (Abubakar and Adebayo, 2014; Abdulkadir, Amano Onibere and Odion, 2019). A study evaluating transitioning from PBT to CBT found reduced concerns about cheating and less requirement for anti-cheating measures (Pawasauskas, Matson and Youssef, 2014). CBT-supporting technologies enable users' identity verification through biometrics. Also, CBT usually has a large question bank; therefore, test questions supplied may not be simultaneously identical and may not be predefined.

UTME is the largest tertiary admission requirement conducted exclusively using a computer. UTME questions are all multiple-choice questions. Sixty (60) questions for the use of English and forty (40) questions each for the remaining three subjects of

choice, making a total of 180 questions with a cumulative maximum score of four hundred (400).

Due to the limited amount of Information Technology (IT) facilities and the huge number of candidates (approximately 2 million), the UTME is usually spread over a couple of days. JAMB does not have the Information Technology capacities to exclusively accommodate all the approximately 2 million candidates writing the exam yearly. Hence, JAMB recruits and approves centers with the required ICT facilities to assist in coordinating and conducting UTME. These centers are spread across the 36 states in Nigeria and the federal capital territory. For example, in the year 2020, JAMB accredited 747 examination centers for the conduct of exams, with Lagos having the most centers-72 and Zamfara State having the least with only six centers. Candidates are assigned to these centers based on their location and given dates and time slots for their respective examinations. As of 2020, students can objectively decide to take a mock exam organised by JAMB a few weeks before the actual examination commencement. The mock examination allows interested students to practice UTME in the actual simulated environment. This test can only be taken in one of the JAMB's accredited centers.

2.3 Research Context

Of all the examinations required for tertiary admission seekers in Nigeria, UTME is unique for exclusively conducting examinations using the computer. The computerised examination has several advantages: fast result processing (Boevé *et al.*, 2015), reducing the cost of the examination, efficient monitoring of student records (Garas and Hassan, 2018) and reducing malpractices to the barest minimum (Abubakar and Adebayo, 2014; Adenuga and Mbarika, 2019). Even with the numerous advantages transitioning into CBT can provide, the peculiarities of Nigeria may hinder the adoption and effective transition to digital technologies in education. Some of these key factors are discussed below:

2.3.1. Infrastructure Challenges:

Lack of Reliable Electricity: ICT tools and infrastructures rely on electricity. However, Nigeria still suffers from unreliable and inadequate power supply. Frequent power outages and the lack of 24-hour electricity have profound repercussions, hindering the use of electronic devices and discouraging investments in digital infrastructure, resulting in substantial challenges for individuals and businesses in accessing and utilising digital technologies (Moyo, 2012; Okunola, Rowley and Johnson, 2017a; Ifere *et al.,* 2022) For instance, Okunola et al. (2017) researched the Nigeria Immigration Service (NIS) web portal. While their primary interest was in the NIS portal, their findings have broader implications, illuminating how the digital divide affects Nigerian citizens. The study underscores the challenges experienced by users, which can be attributed, in part, to the unreliable power supply. Also, Ifere et al. (2022) conducted a comprehensive study on the infrastructural deficit in Africa, including Nigeria. Their research involved interviews with managers and owners of manufacturing SMEs in Nigeria, revealing the unreliability and susceptibility to voltage surges in electricity supply for industrial operations. Therefore, unreliable power supply hampers digital technologies adoption and their efficient use in various Nigerian sectors, including education, businesses, hospitality and health.

Limited ICT Infrastructure: Infrastructure development in Nigeria lags. Around 20% of Nigerians own a smartphone, and only about 30% of Nigerian households own computers in 2022 compared to the UK, where all households with children have a computer (desktop or laptop) (Statistica, 2022a, 2022b, 2023). Also, according to the World Bank's open data record, half of the Nigerian population has no internet connection (World Bank, 2021). The absence of critical components, such as broadband connectivity and comprehensive mobile network coverage, significantly hampers access to digital resources and services (Adomi and Kpangban, 2010; Martens *et al.*, 2020). Insufficient and poor ICT infrastructure may limit economic opportunities and exacerbate disparities in education, healthcare, and access to vital online services (Ifere *et al.*, 2022).

2.3.2 Economic Disparities:

The affordability of digital devices is a significant obstacle to digital inclusion in Nigeria. While the digital age offers vast opportunities for education, employment, and social connectivity, the prohibitive cost of smartphones, laptops, and tablets may create a significant divide. These devices are majorly produced outside the country, and the value of the naira has continually declined over the years. Acquiring and maintaining the necessary ICT for engaging with the digital world may be financially challenging, especially for those with lower economic backgrounds (Bauer *et al.*, 2020). The high cost of data services further compounds the digital divide in Nigeria. Accessing the internet is a fundamental component of digital inclusion, yet the exorbitant prices of internet subscriptions, particularly mobile data, present a formidable barrier for many Nigerians (Tsetsi and Rains, 2017). When the cost of data services exceeds the average income, it discourages individuals from fully utilising the internet or confines their usage to only the most essential tasks, such as communication and basic information retrieval. Therefore, without the required funds, individuals and institutions will be left with no or outdated technology, limiting their exposure to and engagement with digital technologies (Imhanyehor, 2021). Consequently, ICT usage may be limited to only people who have the financial capabilities to bear it.

2.3.3 Lack of Digital Literacy

Digital literacy is crucial for effectively utilising information and communication technologies (ICTs). It encompasses more than just technical knowledge and includes the ability to use computers and the internet as fundamental learning tools (Greiff, Scherer and Kirschner, 2017). The concept of digital literacy has evolved to encompass a broader framework that goes beyond basic technical skills. It involves utilising technology and information effectively and efficiently in various contexts, such as academia, workplaces, and daily life (Preez, 2009). However, the absence of digital literacy programs and training in schools and communities means that many Nigerians, especially students, lack the skills necessary to navigate the digital world. For instance, a study conducted by (Igbo, 2020) examined the impact of undergraduates' academic

background on their utilisation of digital literacy skills for obtaining digital information to solve educational problems. One of the primary challenges discovered was the insufficiency of education and training programmes to improve students' digital literacy competencies. Also, (Omosekejimi *et al.*, 2019) found that most of the lecturers in colleges of education in Nigeria used in their study are not proficient in using Microsoft Suite and cannot apply computers to solve real-life academic problems. If this is the case, such lecturers will not be able to benefit from ICT integration in education and may put their students at a disadvantage.

2.3.4 Urban-Rural and Private-Public Disparities: Urban Development: ICT infrastructure development and digital opportunities have been concentrated predominantly in urban areas. Despite the potential benefits of ICT adoption, many Nigerian rural communities continue to lack access to and use of ICT infrastructure and services (Oluwatayo and Ojo, 2017; Ogbeide-Osaretin and Ebhote, 2020). The digital gap is more pronounced in Africa, particularly in rural regions; there is a limited internet connection and inadequate information technology. This divide exacerbates developing countries' economic, political, and educational disparities (Okunola, Rowley and Johnson, 2017a). In Nigeria, research has revealed discrepancies in ICT access and infrastructure between urban and rural areas, as well as socioeconomic inequities and unpredictable energy, all of which are impeding technological progress and access (Okunola, Rowley and Johnson, 2017). Furthermore, private schools in Nigeria generally have better facilities than public schools and are frequently available to those from rich backgrounds (Olasehinde and Olatoye, 2014). Studies show considerable differences in ICT access and expertise between urban and rural secondary school students in Nigeria (Osuafor and Osisioma, 2014). Furthermore, there is a significant difference in ICT accessibility between the private and public sectors, with private schools having greater resources (Ukpebor and Emojorho, 2012; Mpofu and Chikati, 2013). These disparities in digital technology access and use may contribute to unequal educational opportunities and hinder the overall development of disadvantaged students who lack essential ICT tools and skills.

Consequently, some students are likely disadvantaged when digital technologies like CBT replace traditional non-digital ones. In the case of high-stakes examinations such as UTME, underprivileged students' performance may be affected. Therefore, research is needed to investigate the effect of digitally related individual differences among students taking UTME and their impact on performance in the examination.

2.4 Chapter Summary

This chapter described the requirement for tertiary institution admission in Nigeria, focusing more on UTME. The structure of the exam, its requirements and its function of the examination are discussed in detail. Lastly, the challenges peculiar to Nigeria may pose a challenge to the effective adoption and implementation of CBT on a general scale is discussed.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

The previous chapter described the background of tertiary admission entrance examination in Nigeria and established some challenges that may be related to CBT on such a large scale in the country. This chapter identifies the relevant literature to investigate the current state of research in CBT, the digital divide that may be peculiar to it, and the gaps this research aims to fill.

3.2 Narrative Literature Review

The literature review of this study is narrative. A narrative literature review aims to collect and organise material on a certain topic(s) (Aromataris and Pearson, 2014). It is a detailed examination of current literature that includes both primary and secondary sources to provide brief practical knowledge about a topic (Ferrari, 2015). The fundamental justification for conducting a narrative literature review is that it provides a full overview of the research conducted on a topic, avoiding information overload and focusing attention on the important facts, including strengths and limitations (Siddharth Sarkar, 2021). This evaluation approach allows for the identification of literature gaps and the development of new research subjects.

A literature review can also be carried out in the form of a systematic literature review as an alternate strategy. This methodology is more methodical and is comprised of a series of procedures, such as searching for and selecting pertinent research, evaluating the quality of the studies, and extracting data (Tranfield, Denyer and Smart, 2003; Whittemore and Knafl, 2005). This method effectively answers specific research questions, and the systematic approach makes it possible to replicate findings (Aromataris and Pearson, 2014). In spite of the many benefits that systematic literature reviews offer, narrative literature reviews offer a substantial number of benefits. First, a narrative literature study offers a deeper and more nuanced comprehension of a subject because it investigates the context and history of the subject area (Green, Johnson and

Adams, 2006; Siddharth Sarkar, 2021). Second, it makes it possible to include data that might not otherwise pass a systematic review's high requirements for being included (Siddharth Sarkar, 2021). Finally, narrative literature evaluations incorporate theoretical and philosophical perspectives that may not be represented in a systematic analysis (Green, Johnson and Adams, 2006).

The procedures followed to find relevant literature are broken down into the following categories and shown in Figure 3.1. The first step is to determine the topics that are of interest. The next stage is to search for relevant published material by using predetermined search keywords on the university's integrated database (Suprimo) website, on the websites of predetermined organisations (such as WAEC and OECD), and on Google. Articles are screened initially based on their titles and abstracts and then again based on the information in the articles. To create this chapter, pertinent information was gathered from a selection of the articles.

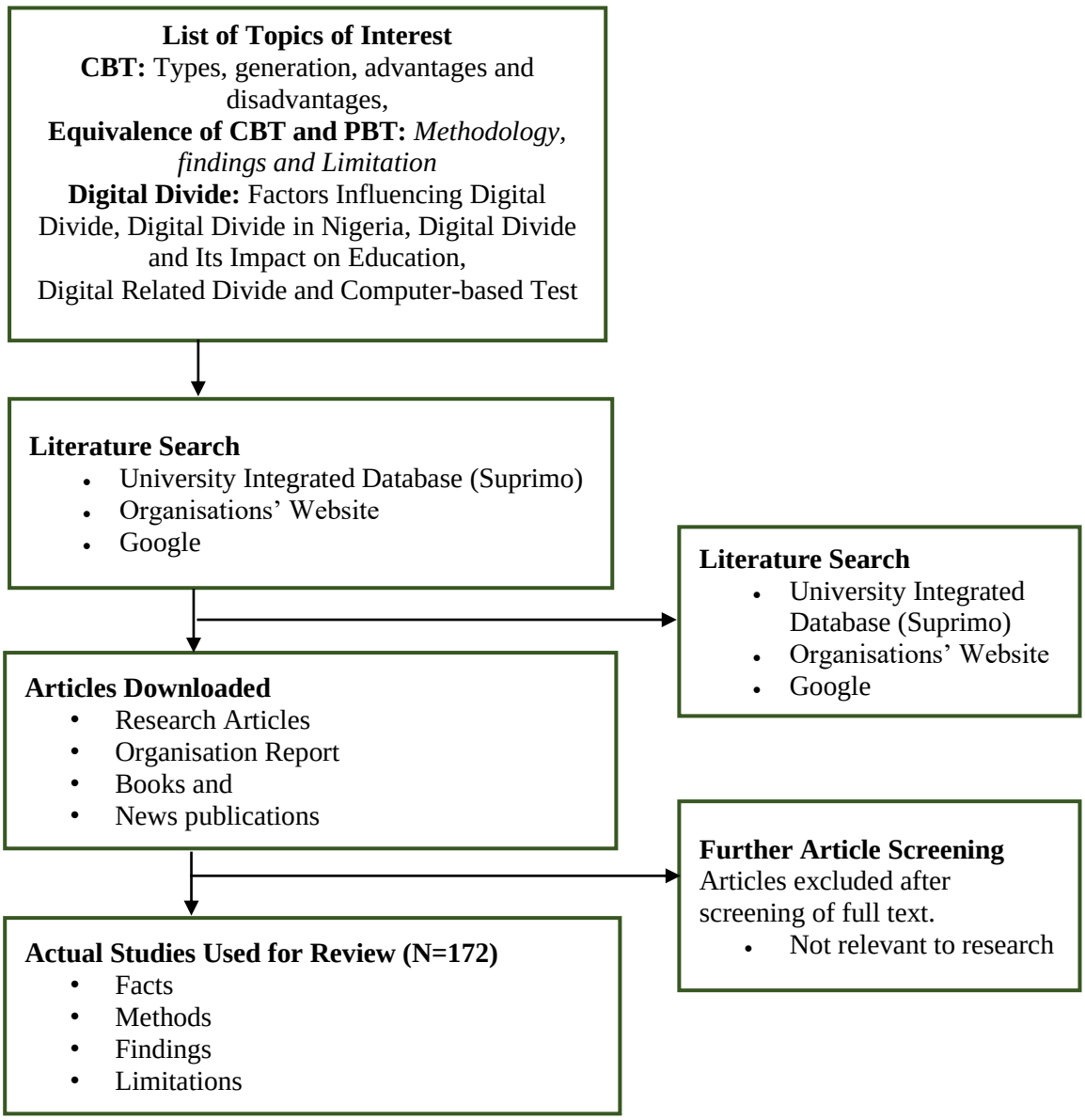


Figure 3.1: Illustration of Literature Collection

3.3 Computers in Assessment

Technology has been incorporated into our daily lives, the educational sector included. Its use has consistently increased in teaching, learning and assessment. Technology has improved the test constructs that are measured, and the testing environments have significantly changed (O'Leary *et al.*, 2018). The novel innovation of technology in assessment can be traced back to IBM Model 805 in 1935 in the United States. The computer was used to score multiple-choice tests on paper and pencil (Parhizgar, 2012).

The machine used could detect pencil markings on a paper test (able to identify the option shaded by test takers in a multiple-choice test), detect the number of correct choices, and report the total marks obtained. The adoption aimed to improve test marking speed and test results' reliability by preventing human error, which is almost unavoidable when the test is hand-marked. A lot have changed since this invention and a lot of examination seems to have moved on from this technology and adopted more sophisticated ones. However, examination bodies that conduct examination for large number of students using PPT still make use of similar technology to grade multi-choice done on PPT. For example, in Africa, NECO and WAEC who conduct exam for hundreds of thousands of students at a time using PPT still make use of similar technology to mark multi-choice questions.

Technological advancements have resulted in computer technology in all assessment stages. Burstein et al. enumerated the major steps involved in test development, which included test design, test construction, item try-out, test item delivery, item management, item scoring, item analysis and item reporting (Burstein *et al.*, 1996). Test design: The planning of new elements for the test, sometimes with a modified justification for the test; Test construction: gathering content data and initial testing of novel test elements; Item try-out: The dissemination and testing of initial test items, the gathering of test results, and the archiving of original test items and their data; Test item delivery: storage and retrieval of data, cellular or other telecommunications, multimedia display, and the gathering of reaction data; Item management: formal process is involved in the storage and updating of test item information; Item scoring: steps involved in determining the scale of test-takers performance which may include interpretation of the score; Item Analysis: provision of a numerical (or other) characterisation of performance, item analysis and interpretation also tie that characterisation to some broader interpretative scheme, such as the performance on other components of a complex skill domain or the scores of other population members; Score reporting: reporting scores to examination candidates. However, test delivery, scoring, and reporting are the top three aspects of technology incorporation in the assessment that have received the researchers' most incredible attention (Parhizgar, 2012).

A concise phase of digital technology integration in assessment can be found in (Bennett, 2015), where he classified the integration into three stages. (1)- The first stage includes the delivery of paper tests using a computer. Tests are primarily used to serve institutional purposes and are usually isolated for single-time use. This stage serves as a preparatory ground for development in later stages of technological integration in assessment since computer capabilities were not used to their full potential. (2)- In the second stage- computer capabilities are stretched, and its power is used to improve assessment stages. It involves the primary attempt to improve some measurement of constructs that are difficult to measure using traditional testing methods. This stage involves the introduction of an innovative item format and automation of assessment processes, including item generation and scoring. Also, the internet is used for internal processes and for giving feedback to test users. (3)- The third stage is purposeful, fulfilling the purpose of both institutional and individual learning. The cognitive principle and domain model are utilised for design, and the test is close to real-life situations. Users' interaction with the computer is improved, and a more advanced test construct is measured. Most large-scale examinations have evolved to adopt at least some of the characteristics of second-generation CBT (Redecker, 2013; Bennett, 2015), such as automated writing task scoring.

3.3.1 Types of Computer-based Tests

The large-scale computer-administered test can be broadly classified into conventional and adaptive computer assessments.

3.3.1.1 Conventional Computer Assessment

Conventional Computer Assessment (CCA) involves administering the same test questions to exam candidates (Mead and Drasgow, 1993). Candidates have an identical range of questions with similar difficulty, and the test is often used to measure a wide range of abilities of the candidate (Mead and Drasgow, 1993). When CCA is internet based, it allows for large-scale examinations to be conducted for students in multiple locations. An example of a CCA examination is the computer version of the International English Language Testing System (IELTS), the most popular international

standardised English competency test. The Internet-based IELTS is very similar (question types, timing, content and grading) to the equivalent exam administered using paper and pencil (IELTS, 2022). Test-takers who take the web-based test benefit from faster result reporting than counterparts who take a paper. However, simple CCA is predefined/fixed; they are not adaptive to examinee choices during an examination.

Traditional testing is ineffective since test questions are predefined (Mead and Drasgow, 1993). CCA tests may be too difficult for those with poor abilities or too easy for examinees with exceptional abilities. Mismatches between examinee aptitude and object complexity may waste testing time and lead to fatigue during a test. Additionally, candidates with exam questions that are too tough may lead to guessing and inaccurate aptitude measurement.

3.3.1. 2 Computer Adaptive Testing

Computer Adaptive Testing (CAT) is one of the essential developments of the 1990 decade (Fulcher, 2000; Parhizgar, 2012). CAT questions supplied to a candidate are not pre-defined tests; test questions are determined during the test time. Questions supplied to the examinee during CAT are adjusted to the capacity of the examinee. Generally, CAT can be of two types- object-based or section based. For object-based CAT, a test taker is presented with a question with a medium level of difficulty. Depending on whether the test taker gets the question right or wrong, the next question's difficulty level is scaled up or down, respectively. Suppose the test taker gets the presented question right; the next question is higher on the difficulty scale. If wrong, a question with a lower level of difficulty is presented. This process is repeated till the test taker completes the test.

On the other hand, for section-based CAT- the test taker completes a section of the test. Based on his/her performance in the section, the difficulty level of the subsequent section is determined. Hence, the difficulty of questions in a section does not change, regardless of whether the test taker gets a question wrong or right. A famous example of section-based CAT is GRE; after an examinee takes the first section of either a verbal or quantitative test, the difficulty of the next section is determined by the user's

previous performance. The advantage of a section-based CAT over an object-based CAT is that test-takers can skip and edit answers within sections. Skipping questions is impossible in object-based CAT since each question must be answered and submitted before a user can proceed to the next question.

CAT is among the most desirable testing methods (Parhizgar, 2012). This is because they provide some merits that are not easily accessible in traditional testing methods. These include easy identification of low and high-performing students and the existence of an enormous question bank that can easily be suited to each test taker's needs. As a result of this- there is increased security of the test since there is a wide variation in questions presented to each test taker (Parhizgar, 2012). However, the significant repository questions are also a drawback since creating and classifying each question accurately can be costly and challenging (Fulcher, 2000; Parhizgar, 2012). Overall, technologically advanced tests can improve test-takers motivation and engagement during computer-based assessments (Redecker, 2013; Bryant, 2017; O'Leary *et al.*, 2018).

3.3.2 Merits of Computer-based Testing

The computerised test has gained popularity worldwide as a means of administering assessments, examinations, and other forms of testing in various contexts. The use of CBT has also extended beyond the education sector, with government agencies and private companies using CBT for staff recruitment and training. The increasing use of CBT is due to its numerous advantages over traditional testing methods. These advantages are enumerated and discussed in detail below.

- ***Cost and Time Reduction:*** Adopting CBT as a replacement for PPT reduces the cost and time taken to plan and administer a test (Naus, Philipp and Samsi, 2009; Terzis and Anastasios A Economides, 2011; Terzis, Moridis and Economides, 2013). This includes test production, distribution, and grading costs and time. The cost and time involved in printing test papers and examination answer sheets, distributing materials to test centers and recovering the test paper

for grading are eliminated. For instance, where there is an error or mistake with the printed examination papers, another set of questions may need to be printed when a PPT test is administered. However, in CBT, examination questions can easily be edited, and tests can be redeployed to the various test center at any time before the test. Similarly, after tests have been completed and submitted, the computer can immediately assess the submitted answers and assign the corresponding grade obtained by examination participants. However, when PBT is administered on a large scale (such as UTME, with approximately two million examination candidates yearly), an additional cost and time are incurred to distribute and collate examinations and transport scripts to marking centers. Also, more human resources will be required to manage the cumbersome process of the PBT examination.

- ***Improved Security and Integrity of Examination:*** CBT allows for improved security and integrity. Test questions are easily stored in remote and secured cloud locations in CBT-conducted examinations. The test questions may be deployed to various test centers when the examination begins. CBT enhances examination questions' security (Terzis, Moridis and Economides, 2013; Stavros A. Nikou and Economides, 2016; Ebimgbo, Igwe and Okafor, 2021). The number of people who have to assess the questions before the examination is reduced to the bare minimum. Examinations conducted through a computer can be accurately graded and free from human error (Ndunagu, Agbasonu and Ihem, 2015; Prisacari and Danielson, 2017b; Adenuga and Mbarika, 2019). Hence, CBT improves the reliability of the assessment conducted through it. Unlike the PPT examination, the script must be printed long before the test time or date, especially where test papers must be transferred to different regions or states. This PBT drawback means many people (such as the printing officer, maintenance specialists, drivers, and storekeepers) who may be compromised have access to examination in test production, storage and distribution. Also, a similar chain is followed after the examination is conducted to transfer the script back to the collation point for examination grading. This long examination

transfer chain allows for loopholes that may compromise the examination in the printing, transportation, storage, and grading stages.

- ***Real-Time Feedback:*** CBT allows students to get real-time feedback (Terzis and Anastasios A Economides, 2011; Adesina *et al.*, 2014; Stavros A Nikou and Economides, 2016). A CBT examination script can be marked and graded immediately by the computer. The ease provided by immediate feedback in CBT helps shorten the waiting time for the test results. For example, UTME (computer-based assessment in Nigeria) test results are usually available 24 hours after the test. On the other hand, SSCE (traditional PPT) takes a couple of months before results are released to examinees. Real-time feedback is especially advantageous for users taking practice tests- since exam takers can quickly identify their weaknesses and strengths before taking the actual examinations (Gikandi, Morrow and Davis, 2011; Rolim and Isaias, 2018). Consequently, candidates can address their weaknesses and work on them to improve their performance in the actual examination.

- ***The flexibility of Time and Space:*** Computer-based Testing allows a test to be deployed remotely and taken anywhere and anytime (Terzis and Anastasios A Economides, 2011; Terzis, Moridis and Economides, 2013), as long as there is a computer and internet connection. Hence, people do not have to be restricted by location or a specific time. Similarly, since fewer resources, especially human resources, are involved in conducting and grading CBT, an assessment using computers can be conducted several times compared to paper-based counterparts. For example, in an international examination such as the GRE, an American standardised examination, test takers do not have to travel to America to take the test. Examinees can easily choose from multiple days and time slots available in their locality throughout the year.

- ***Design of Unique Assessment:*** computer can be used to create and deploy interactive examinations that may not be possible using PPT. These tests are not based solely on choice selection or typing in text and figures. For example, a 'Word Arena Test' requires examinees to adjust a plant's food to create the tallest

plant, and users can view the effect the proportion of each plant's food has on the plant's growth (Richardson *et al.*, 2002). Similarly, computers can collect data on the examinee and their interaction with the examination that might not be accurately collected in traditional PPT mode. For example, accurate data can be collected on the amount of time spent on each question, the number of mouse clicks per question, examinee gestures when attempting questions, and the relation this has with the correctness of the examination taken (Greiff, Scherer and Kirschner, 2017). Such data can be collected individually on the examinee and can be used in analysing examination and test-takers' interactions with the examination. Evaluation of users' interaction with a computer can be used to draw valuable insights, such as tracking progress that can be used to improve the quality of training and examination (Adesina *et al.*, 2014). A computer can be used to conduct adaptive tests easily suited to individual needs (Fan, 2011).

- ***Automated Record Keeping:*** Computers enhance effective record keeping (Ndunagu, Agbasonu and Ihem, 2015; Adenuga and Mbarika, 2019). Another advantage of CBT is that the examinee of computer-based assessment results can be collected automatically (Terzis and Anastasios A Economides, 2011; Adenuga and Mbarika, 2019; Nikou and Economides, 2019). The results of multiple examinations for numerous examinees can easily be collected and stored over multiple years. These results can form an extensive repository of data that can be analysed to recognise examination patterns. For example, clusters of students who perform very well in a particular examination can be identified, and the characteristics of the high performers can be investigated. Information gathered can be used to guide weak performers in the examination to improve their performance. Similarly, examination results can be monitored over several years for a large sample size, allowing test providers to identify the effects of change in policy on results and test-takers. Therefore, examination stakeholders can recognise effective policies and those not improving examinees' test experience and examination quality.

3.3.3 Demerits of Computer-based Testing

The use of computerised tests has several advantages that have been stated above. However, adopting CBTs may have potential drawbacks that may be exacerbated in developing countries. These drawbacks are listed below:

- ***Cost Intensive to Set up and Maintain:*** one of the most important costs connected with computerised testing is the initial cost of establishing a CBT infrastructure (Mulyawansyah, Umar and Jaya, 2022). This covers the expense of obtaining and maintaining required hardware, software, and technical support employees. There is a need for the computer systems and networks used for testing to be current and capable of handling the extra traffic caused by CBT. Furthermore, test takers may require specialised equipment, such as headphones or webcams, to complete the examinations, which may involve additional expenditures. Test development is another costly part of CBT. Developing computer-based exams, as opposed to traditional paper-and-pencil examinations, involves specialised knowledge in test design, item authoring, and psychometric analysis. Developing high-quality CBT items that are valid, reliable, and bias-free needs careful planning, development, and testing. This procedure may be time-consuming and costly, especially for organisations lacking the essential skills and resources. CBT can also be expensive to administer. CBT testing requires a strong internet connection and specialised software to offer exams, gather replies, and score results. Furthermore, testing centers may require experienced workers to oversee test takers, solve technical difficulties, and assure test security. All of these variables can greatly raise the overall cost of CBT administration.

- ***Test Security Concerns:*** Computer-based testing may eliminate examination malpractices related to having access to the exam questions before the examination and physical interactions during the exam; however, other security concerns may arise when CBT is implemented. One of CBT's most serious security problems is the possibility of digital cheating (Malec, 2020). Digitalised examinations may make it easy for test takers to acquire and exchange exam

materials and search for answers on the internet. This poses a considerable problem to test administrators and calls into question the validity and reliability of test outcomes (Roever, 2001). To secure the integrity of CBT, sophisticated technologies like video surveillance systems, biometrics and artificial intelligence may be required. Another source of concern is the possibility of hacking and cyber assaults. Unauthorised access, data breaches, and other security hazards may befall CBT systems and networks. Hackers may attempt to get access to test questions, answers, and results, jeopardising the whole testing system's security. This can have a substantial impact on the testing organisation's reputation as well as the validity of the test findings. Organisations must invest in sophisticated security measures such as firewalls, encryption technology, and multi-factor authentication to prevent such assaults. Finally, privacy problems may also arise as an issue in CBT. Personal information such as the test-taker's name, address, and other sensitive data may be acquired during the testing procedure. It is critical to preserve and secure sensitive data to avoid unauthorised access or misuse. Organisations must follow privacy legislation and standards to guarantee that personal information is treated with care and respect.

- ***Technical Difficulties during Examination:*** Hardware and software failures are two of the most critical technical issues that might develop during CBTs (Roever, 2001; Malec, 2020). CBT examinees may experience issues such as frozen displays, system crashes, power loss and hardware failures, which can interrupt the testing process and result in data loss. These difficulties may arise as a result of old equipment, insufficient system maintenance, or compatibility issues between various hardware and software components. To overcome these issues, testing organisations must ensure that their hardware and software systems are current and well-maintained and that technical help is easily accessible. Another technical issue that might develop is network connectivity problems. CBT frequently necessitates Internet connectivity or other networks to obtain exam materials or submit replies. Exam takers may be unable to access the exam or

submit their replies if there are network challenges, resulting in delays, frustration, and data loss. To solve these concerns, organisations must ensure that their networks are dependable and that backup procedures are in place to manage connection outages. Furthermore, compatibility concerns between various operating systems, web browsers, and other applications might cause technical difficulties (Roever, 2001). Different operating systems may have different compatibility concerns with distinct software programmes, resulting in errors or preventing test takers from accessing the test. Finally, there might be problems with user interface design and accessibility (Wibowo *et al.*, 2016). Exam takers may have difficulty navigating the testing interface, comprehending the instructions, or gaining access to exam materials. Individuals with disabilities, such as eyesight or hearing difficulties, may find this especially difficult. Therefore, organisations must ensure that their testing interfaces are easy to use, accessible, and intended to satisfy the requirements of all test takers.

- ***Digital Literacy Concerns:*** To successfully complete a test on a computer, at least some amount of computer literacy is required (Kirsch *et al.*, 1998; Roever, 2001). The amount of computer literacy required to complete the examination may vary depending on the nature of the assessment. For instance, a multi-choice test may need the examinee to have basic mouse and keyboard capability. In contrast, in an examination where test responders must submit an essay(s), apart from their knowledge, the examinee's typing speed will be a significant component that may affect their performance in the examination (Roever, 2001). Many people with low exposure to the computer, particularly older people and those from low-income families, may lack the required abilities to traverse computer systems and software. They may have difficulty understanding the instructions, navigating the testing interface, or gaining access to test materials (Wibowo *et al.*, 2016). This might result in poor performance (Dooey, 2008). Computerised test management must make certain that their CBT systems are created with accessibility and diversity in mind.

As discussed earlier, CBT has numerous advantages and disadvantages. Specifically, its advantages may make it very attractive in efficiently conducting large-scale examinations such as UTME. However, research has also demonstrated that the examination mode may affect test performance (Emerson and MacKay, 2011; Hosseini, Abidin and Baghdarnia, 2014; Abdulkadir, Amano Onibere and Odion, 2019). Therefore, when an assessment mode is replaced by another (e.g. PBT to CBT), or when the two modes are used concurrently (exam candidate can choose between CBT and PBT), a crucial question is raised: does the method of delivery impact test performance?

3.4 Equivalency of Paper-based Test and Computer-based Test

The literature study shows contradictory results in comparing CBT and PPT. Some studies found significant differences in the comparability of the PPT and CBT test modes (Hosseini, Abidin and Baghdarnia, 2014; Feinkohl, Cress and Kimmerle, 2016; Guimarães *et al.*, 2018), while others reported similarities (Özalp-Yaman and Çağiltay, 2010; Piaw Chua, 2012; Le Corff, Gingras and Busque-Carrier, 2017; Blitzblau and Horton, 2019; Soto Rodríguez, Vilas and Díaz Redondo, 2021) and some studies like (Zheng and Bender, 2019) report mixed findings. Some of the studies that investigated the comparison of students' performance in traditional test mode and computerised tests are discussed below, and Table 3.1 summarises the findings from the studies.

Akdemir and Oguz (2008) compared CBT and PPT with students from public universities in Turkey. The research assesses students' performance on the two exams and examines gender performance. The 47 students who participated in the research had previously attended an educational measurement course taught by the same instructor. The students were first tested using a multi-choice PPT, and then CBT was administered to the same students four weeks later. The findings reveal that undergraduate students performed similarly in both exams. There was no statistically significant difference in participant test results in CBT and PPT. Notably, students used in this research have previously completed a computer course in their department and are assumed to have the necessary degree of competency to take CBT.

Another CBT and PPT comparability study was conducted in Turkey by (Özalp-Yaman and Çağiltay, 2010). The research used two hundred and nine (209) undergraduate students. Data about Students' characteristics (gender, department, computer ownership, computer experience, and cumulative gross percentage) were collected before the experiment. The students were divided into two almost equal groups and made to take their chemistry test as either PPT (113) or CBT (96). After the test, seven (7) of the CBT participants were interviewed to get information about their opinion of CBT. Comparing students' performance in CBT and PBT showed no significant difference. Initially, test takers were reluctant to take tests using CBT. However, after taking the test, they felt comfortable with the mode and did not feel CBT affected their performance. Furthermore, the gender of the student does not have a significant relationship with test-taker performance. However, most students who took the test are familiar with computers; ninety-seven per cent (97%) of them own a personal computer. Hence they are most likely frequent computer users.

Boevé *et al.* (2015) compares students' performance in CBT and PPT in a sample drawn from undergraduate psychology students. Additionally, students' acceptability of CBT was evaluated using a questionnaire. The students were divided into two groups- each group took PPT and CBT in midterm or end of term interchangeably. The study results show no significant difference between the student's assessment scores in CBT and PPT. From the survey, fifty per cent (50%) of students prefer PPT, twenty-eight per cent (28%) prefer CBT, and the remaining students are indifferent about the favourability of both tests. The authors suggest that increased students' familiarity with computer-administered tests will likely increase students' acceptability of CBT.

Another study evaluates the equivalency of test scores in CBT and PPT (Garas and Hassan, 2018). The researchers used 78 financial accounting UAE undergraduate students to conduct controlled studies- examination and contextual variables-instructors, the timing of exams and the gender of test-takers are standardised. The study is done in a segregated community (males are separated from females and have different campuses). Hence, female students take classes and assessments separately from male students. The introductory to financial accounting students were divided into three (3)

female groups and one (1) male group. Each group took classes and assessments separately. Four specific tests contributing to the cumulative score were administered with a one-week interval between them. The test was taken interchangeably- students took two tests in CBT and 2 in PPT. Before taking the actual test, students had a mock PPT and CBT to familiarise students with the test structure and each test mode. The research findings show no significant difference in the performance of CBT and PPT. However, the gender effect was present- the males performed better in CBT than in PPT, while the females performed better in PPT. Given that this study is performed in a segregated community, the findings of this research may not repeat in other cultures.

A more recent study favouring the equivalency of CBT and PPT by (Guimarães et al., 2018) investigates the impact switching from PPT to CBT has on student performance. In addition, a survey was done to gather students' opinions about the change. Medical students taking a clinical anatomy course were used in the study. The students were examined with two test types: theory and practical tests. The students (265) are divided into two groups, each of the groups is made to take either two (2) distinct PPTs or two (2) distinct CBT of theory and practical (one after the other). In the first test phase, students who took PPT performed better than CBT students. However, there is no significant difference between PPT and CBT test-taker performance in the second phase of the test. The research suggests that test mode will not affect test performance after familiarisation with CBT. By the end of the second test on the computer, students' performance in CBT did not just level up with PPT. However, there was an increased positive opinion about CBT and reduced anxiety about CBT. The most-reported positive aspect of CBT is the prompt feedback feature. In contrast, the most reported negative feature is interface and usability.

Among the authors that report inequality of student performance in CBT and PPT is (Hosseini, Abidin and Baghdarnia, 2014) compare the performance of Iranian undergraduate students in a multi-choice reading comprehension test. The relationship between prior computer familiarity and computer attitudes and test performance was also examined. The studies used one hundred six (106) English students major. Two closely similar PPT and CBT were administered to the students with two weeks

intervals between them. Prior to taking CBT, students had brief training on CBT. Similarly, students took demographic information, computer attitude, and computer familiarity questionnaire. Approximately 10% of the test takers were interviewed to validate the questionnaire. The research findings show a significant difference between students' scores in CBT and PPT with better performance in PPT. However, the difference in performance is not linked to prior computer familiarity or familiarity with CBTs. Students have better attitudes toward computer-administered tests but perform better on paper tests.

Bennett *et al.* (2008), a research sponsored by National Centre for Education Statistics, USA, investigates test mode's effect on examinee performance. The study has the following research questions: (1) what effect does test mode have on the total score obtained by the examinee? (2) how does test-takers background (race/ethnicity, gender, parent's education level, type of school and region located) affect performance across test mode? (3) does computer familiarity have a significant effect on CBT performance? The sample for the research was drawn from 8-grade pupils in a public and private school in the US. One thousand sixteen (1016) students took mathematics examination while 954 took similar tests in PPT. Also, the participants' demographic information and computer experience were collected to facilitate answering research questions (2) and (3). The finding of the study concerning the research question is: (1) Students who took their test on paper performed better than the participants who took theirs on the computer (2) There is no significant relationship between the examinee's background and performance (3) The higher the student computer familiarity, the better the student's performance. Most of the research participants are familiar computer users (Ninety per cent (93%) of them use computers to search for information).

The performance of grade 11 and 12 Chinese secondary school students in English language listening CBT and PPT was compared (Coniam, 2015). Four hundred question bank was created; subsequently, questions were drawn to compose PPT and adaptive CBT. Before taking the test, students had a hands-on CBT test until they were comfortable taking the test. The findings of the research show that test takers perform better in PPT than in CBT. Similarly, an interview was conducted to investigate the

gender perception of CBT, and PPT was also evaluated. Results show that males prefer CBT to PPT, while females prefer PPT to CBT.

On the contrary, results from (Clariana and Wallace, 2002) show that students have better performance in CBT. The study investigated the comparability of the performance of undergraduate business students in Computer Fundamentals CBT and PPT. One hundred five (105) students were used in the study- they were divided into two groups, and each group took either PPT or CBT. Students who took CBT outperformed students who took PPT. Computer familiarity and test-taker gender have no significant relationship with CBT performance; only content familiarity has a positive relationship with test performance. Higher-attaining students' performance benefited from CBT more than low-performing students. Another study in the USA by (Gallagher, Bridgeman and Cahalan, 2002) also shows students have better performance in CBT when compared to PBT. The study examined the impact of changing from traditional test mode (PPT) to CBT in the United States of America's National testing programs: GRE, Praxis, SAT1, and GMAT. Approximately 200,000 samples were used in the research and were drawn from previous studies. Examinations in PPT and CBT were compared to identify if any test modes are a disadvantage for some racial/ethnic groups or gender. Results of the study show that African-America and Hispanics performed better in CBT. The female examinee performs better in PPT in comparison to CBT.

Lastly, studies like (Zheng and Bender, 2019) report inconclusive findings in comparing the equivalence of performance in CBT and PBT. The study investigates the acceptance of computer-based learning and CBT (ExamSoft), factors influencing the acceptance and the effect ExamSoft has on students' performance at a medical school in the USA. Results show that students generally embraced ExamSoft as a testing instrument and recognised its potential to help to learn. CBT perceived usability and convenience of use were both significant predictors of student acceptance. Computer proficiency and prior CBT experience did not substantially influence CBT acceptance. However, whether pupils fared better on computerised versus paper exams was the subject of conflicting results from t-tests.

According to the existing research, there are inconsistent outcomes when comparing students' performance in CBT and PBT (see table 3.1 for the summary of studies). The American Psychological Association (APA) produced a series of guidelines to emphasise good practice and eradicate computer/Internet testing problems. APA mandates that all impacts brought on by computer test administration must be eradicated or considered when interpreting scores (American Psychological Association, 1986; Bugbee, 1996). Most studies usually focus on establishing the statistical equivalency of CBT and PPT. However, (Honaker, 1988; Mcdonald, 2002) emphasise the need to examine the equivalency of examinee experience when taking CBT and PBT. Therefore, individual responses to the assessment experience are a legitimate subject in the test equivalent study.

Table 3. 1: Summary of Research Comparing PBT and CBT Performance

Author	**No Participant**	**Tool**	**Findings**	**Country of Research**
(Akdemir and Oguz, 2008)	47 university students	Educational Measurement Assessment	Equivalent Test Score	Turkey
(Özalp-Yaman and Çağiltay, 2010)	209 university students	Chemistry Test, Biodata Form and Computer Perception Interview	Equivalent Test Score	Turkey
(Boevé *et al.*, 2015)	401 university students	Bio psychology test and questionnaire	Equivalent Results	Netherlands
(Garas and Hassan, 2018)	78 university students	Introductory Financial Accounting Assessment	Equivalent Results	UAE
(Guimarães *et al.*, 2018)	265 university students	Anatomy Assessment	Equivalence after accumulative CBT experience	Portugal
(Hosseini, Abidin and Baghdarnia, 2014)	106 university students	English Assessment	Better PPT Performance	Iran
(Bennett *et al.*, 2008)	1970 elementary /secondary school pupils	Mathematics Assessment	Better PPT Performance	USA
(Coniam, 2015)	115 secondary school students	English Language Listening Test	Better performance in PPT	China
(Clariana and Wallace, 2002)	105 university students	Computer Fundamental	Better performance in CBT	USA
(Gallagher, Bridgeman and Cahalan, 2002)	200 thousand USA national examinees	GRE, GMAT, Praxis, SAT1	Better performance in CBT for ethnic group Better performance in PPT by female	USA
(Zheng and Bender, 2019)	34 Dental surgery students	Medical School Examination	Inconclusive Results	USA

3.5 Digital Divide

The digital divide refers to the unequal distribution of information and communication technology infrastructure, such as the internet, across individuals, homes, enterprises, and geographical areas belonging to different socio-economic classes (Cruz-Jesus *et al.*, 2016b; OECD, 2016; Okunola, Rowley and Johnson, 2017b; Scheerder, van Deursen and van Dijk, 2017; Wamuyu, 2017). (Ferguson and Damodaran, 2018) states that a digital divide usually exists where there are disparities in three things:

- **Access Divide:** The access divide refers to inequalities in internet and digital device access. People on the wrong side of this divide often lack the means to access digital devices and connect to the internet, which hampers their ability to access and share information (Hargittai, 2010). This results in a limited engagement with digital resources, including critical information sources.
- **Usage and Skills Divide:** The divide between usage and skills underscores inequalities in effectively utilising digital technologies. While some individuals have digital devices and internet access, they may not harness their full potential due to a lack of digital skills or comprehension (Hargittai, 2010; Aissaoui, 2022). This may hinder their capacity to leverage digital resources for decision-making and problem-solving. The skills divide emphasises the differences in digital literacy and competencies, leaving those with low digital skills significantly disadvantaged in an increasingly digital world. Such individuals may encounter difficulties in searching for information efficiently and critically evaluating online sources, leading to less informed information behaviour.
- **Motivation and Relevance Divide:** Those who are highly motivated are more likely to engage with technology actively, seeking out features and content that they find valuable and meaningful (Calvo-Porral and Pesqueira-Sanchez, 2019; Fu-hai, Yu and Xi, 2022). In contrast, individuals with low motivation may be less inclined to explore and use digital resources, which can exacerbate the gap between those who fully embrace technology and those who do not.

3.5.1 Factors Influencing Digital Divide

As highlighted by Khalid and Pedersen in their 2016 systematic literature review, the digital divide is a complex issue influenced by multiple and interrelated factors (Khalid and Pedersen, 2016). They identified three key categories of factors responsible for the digital divide:

- **Social Factor:** regardless of country, socially vulnerable populations are digitally excluded (Warren, 2007; Lane, 2009; Brown and Czerniewicz, 2010; Khalid and Pedersen, 2016). Social isolation can lead to digital exclusion, further perpetuating and worsening social exclusion (Warren, 2007; Khalid and Pedersen, 2016). According to (Sims, Vidgen and Powell, 2005), vulnerable social groups had the lowest utilisation of ICTs, indicating social exclusion. Social exclusion can be caused by financial challenges, social deprivation (poor education or health), disassociation, marginalisation, lack of access to public and private services and infrastructure, low motivation, and societal beliefs (Sims, Vidgen and Powell, 2005; Warren, 2007). This applies to both established and developing countries (Khalid and Pedersen, 2016). For instance, A considerable portion of England's population faces social and digital exclusion due to the inability to use the Internet due to various factors, notwithstanding the success of ICTs in the region (Warren 2007) due to. 1. Limited funds for computer hardware and Internet access; 2. Limited engagement, confidence, understanding, and motivation; 3. No public Internet access due to distance and transportation; 4. Dyslexia, language, or cultural barriers; and 5. Inability to use digital resources because of mental and physical challenges.
- **Digital Exclusion:** refers to the population of people who fall on the wrong side of the digital divide or the line that separates those who have access to digital advancements from those who do not. Digital exclusion underscores the importance of technological hardware and internet services (Khalid and Pedersen, 2016). In developing countries like Nigeria, where electricity is not constant and unavailable in some areas, specific population groups may be unavoidably digitally excluded. Therefore, digital exclusion refers to a situation

in which a particular sector of the population suffers significant and possibly indefinite disadvantages in utilising information technology through factors out of their direct control (Warren, 2007; Khalid and Pedersen, 2016).

- **Accessibility**: is closely linked to geographical, demographic, and socio-economic factors (Khalid and Pedersen, 2016). The rural-urban divide, unequal distribution of information and communication technology (ICT) resources, and disparities in information literacy all play a role in determining the level of technology access and competency (Khalid and Pedersen, 2016). Demographic factors such as age and gender, socio-economic elements like income and education, as well as cultural factors including belief systems and language competency, all contribute to this complex landscape (Scheerder, van Deursen and van Dijk, 2017).

Previous research underscores that the digital divide is not solely a matter of having or lacking access to technology; it's a multifaceted issue influenced by social, economic, and geographical factors and individual characteristics. Understanding these factors is crucial for developing effective strategies to bridge the digital divide and promote digital inclusion across diverse populations. This perspective is reinforced by the work of scholars like (Okunola, Rowley and Johnson, 2017b; Scheerder, van Deursen and van Dijk, 2017; Wamuyu, 2017), who have also examined the complex elements that contribute to digital disparities in today's society.

3.5.2 Digital Divide in Nigeria

The available research on the digital divide in Africa underscores the stark disparities, particularly in rural areas (Mpofu and Chikati, 2013). These regions grapple with limited internet access and often lack the necessary information technology infrastructure (Thompson and Walsham, 2010; Okunola, Rowley and Johnson, 2017b; Azubuike, Adegboye and Quadri, 2021; Olanrewaju *et al.*, 2021) Consequently, the digital divide in Africa is more pronounced when compared to the developed world (Khalid and Pedersen, 2016). This pronounced divide is evident in the substantial gap in internet and information technology access between urban and rural areas in countries

like Nigeria and among different socio-economic strata (Khalid and Pedersen, 2016; Okunola, Rowley and Johnson, 2017b).

In their 2017 study, Okunola et.al. investigated the digital divide in Nigeria (Okunola, Rowley and Johnson, 2017b). They gathered data on ICT use and access, focusing on how citizens accessed the Nigeria Immigration Service Website, a crucial platform for individuals seeking international passports. The study's findings unveiled significant disparities in technology access across different groups. According to the research, participants located outside Nigeria and those residing in urban areas exhibited more robust access to ICT resources and supporting infrastructure when compared to their counterparts in Nigeria's rural regions. Furthermore, the study revealed that Nigerians who are residents, particularly in urban areas, access online services primarily through mobile devices and in business centers. In addition to regional disparities, the research highlighted the presence of stark socio-economic inequalities within Nigeria. These inequalities, coupled with the challenge of unstable electricity supply, significantly impede technological development and access throughout the country. This study underscores the multifaceted nature of the digital divide in Nigeria. It highlights the need for targeted interventions to bridge these gaps and ensure equitable access to digital resources and services for all citizens.

In Nigeria, the educational landscape encompasses publicly owned schools, funded by public resources and offering free or subsidised education to local children, and private secondary schools established and managed by private individuals, organisations, or mission agencies. Public schools are sustained through taxpayer funds, prioritising the educational needs of the community or district's children. In contrast, private schools serve as complementary educational institutions designed to enhance the government's efforts in delivering high-quality secondary education to Nigerian youth. However, private schools typically require substantial fees for student enrolment. In general, private schools boast superior infrastructure to their public counterparts. However, their accessibility is limited to students whose parents can afford the associated costs (Olasehinde and Olatoye, 2014). As a result, disparities in digital technology access are expected to manifest between public and private schools and

within the context of urban-rural distinctions. These variations in educational resources and access to technology further emphasise the multifaceted nature of the digital divide, demonstrating how socio-economic factors and school ownership contribute to inequalities in students' digital learning experiences.

As exemplified by Osuafor and Osisioma's research, which investigated the access to Information and Communication Technologies (ICTs) among secondary school students in Anambra state, Nigeria, the digital divide remains a pertinent issue (Osuafor and Osisioma, 2014). This study highlights the discrepancies between urban and rural schools, offering several significant conclusions that shed light on the unequal distribution of ICT resources. Notably, the research unveiled a substantial disadvantage for Nigerian students and a contrast in ICT availability between urban and rural schools. A mere 13.5% of students in rural schools reported having access to ICT devices, while 32.6% of their urban counterparts enjoyed the same privilege. These findings underline a generally low level of access in Nigerian schools and a pronounced urban-rural digital divide, where students in urban areas have more access to ICT resources, potentially giving them a competitive edge in the digital era. Furthermore, the study also emphasised that urban students possessed significantly higher levels of ICT knowledge when compared to their rural counterparts. This discrepancy in ICT knowledge highlights the broader challenges faced by students in rural areas, who may not have the same opportunities for digital literacy and skill development.

Similar inequalities in ICT access were reported by (Ukpebor and Emojorho, 2012; Mpofu and Chikati, 2013), who noted substantial differences between the private and public sectors in developing countries. High-end private secondary schools demonstrated ample ICT resources integrated into teaching and learning processes, providing students with advanced digital learning opportunities. In contrast, government-managed public schools and middle-class private schools faced a significant lack of digital infrastructure.

The implications of the digital divide extend far beyond mere access to technology. Numerous challenges hinder students' productive engagement with digital technology even when they have physical access to digital infrastructure. In a study

conducted in Bangladesh, findings illustrate this issue, with most students having physical access to ICT. However, only 32.5% are able to attend online classes without disruptions (Badiuzzaman *et al.*, 2021). Notably, 34.1% of students identified high data costs as a significant barrier, while 39.8% cited poor network infrastructure as a major obstacle to participating in online learning activities. This highlights that even when students in developing countries have the physical means of access, they may encounter challenges concerning access quality and subscription maintenance. Specifically, in Nigeria, unstable electricity is a drawback to technological development and access in Nigeria. This situation prevents users from fully capitalising on their physical access.

These disparities emphasise how socio-economic factors and educational ownership contribute to the widening digital divide, impacting students' access to technology and digital education in developing nations. They reverberate across socio-economic, political, and educational dimensions. In developing countries, the digital divide can exacerbate existing disparities, creating a ripple effect of inequality (Van Dijk, 2006). Identifying and addressing these disparities is vital to ensure equitable opportunities for all students, regardless of their geographical location or socio-economic background.

3.5.3 Digital Divide and Its Impact on Education

The adoption of technology in education has resulted in more efficient teaching and learning. Technological adoption has improved educator and student engagement in the learning environment, allowing for individualised and self-paced learning, higher academic achievement and improved student engagement and attitudes towards learning (Carlson, Peterson and Day, 2020). However, the digital divide has significant educational implications for certain groups (Cruz-Jesus *et al.*, 2016b; Di Pietro, 2021; Park, Ramirez and Sparks, 2021; Cheshmehzangi *et al.*, 2022). Students and teachers who lack access to technology are at a disadvantage compared to their peers. According to the National Center for Education Statistics (NCES), students in low-income families are less likely to have computer or internet access at home (NCES, 2018). This lack of access means that students may not have the necessary skills to navigate digital tools

and platforms that are commonly used in schools. Also, teachers in schools with limited resources may not have the training or resources to integrate digital tools into their teaching effectively (Radovanović, Hogan and Lalić, 2015). For instance, a study conducted in Zaria local government, Nigeria, found that students and teachers are not adequately exposed to computer technologies and do not use them in formal teaching and learning (Abba and Abubakar, 2020). Therefore, unequal access to technology limits learning opportunities, exacerbates existing disparities, hampers educational achievement, and restricts access to educational resources.

- **Impact on Learning Opportunities:** Unequal access to technology limits learning opportunities for students. The disparity in access to digital resources can hinder students' and instructors' ability to engage in online learning, access educational materials, and participate in digital learning platforms (Hargittai, 2002; Zarei and Mohammadi, 2021). For example, (Azubuike, Adegboye and Quadri, 2021) highlight significant disparities in students' access to remote learning opportunities during the COVID-19 pandemic. Affordability issues related to phone credit and internet data were the primary challenges identified, along with additional concerns about electricity and device access. Notably, students in government schools faced more difficulties accessing digital tools and were less academically engaged compared to their peers in private schools, revealing a significant association between school type and the challenges students encountered in online learning during the pandemic. Also, (Ndlovu, 2021) highlights the positive impact of assistive technology (AT) on students with disabilities in higher education. However, students without access to AT may face significant challenges accessing educational materials and participating fully in academic activities. As a result, students on the wrong side of the digital divide may miss out on valuable educational resources and opportunities.
- **Impact on Educational Achievement:** The digital divide may have a direct effect on educational achievement (Mehrvarz *et al.*, 2021; Pala and Başıbüyük, 2023). (Mehrvarz *et al.*, 2021) found that students with higher levels of digital competence demonstrated better academic performance. The research highlights the importance of students' digital competencies in relation to their academic

performance. The study revealed a positive relationship between students' digital competence, digital informal learning, and academic performance. Furthermore, (Alam, Ogawa and Islam, 2023) found that students from their study lack access to essential technological devices and digital literacy skills. This, in turn, has had a detrimental impact on their academic performance, particularly in the context of the growing importance of e-learning. This underscores the critical connection between digital access, digital literacy, and academic success, especially with the increasing reliance on e-learning platforms in education. However, students without access to technology may struggle to develop digital skills and competencies, putting them at a disadvantage in the digital age. This lack of digital literacy can hinder their ability to engage with online learning platforms, conduct research, and collaborate digitally, limiting their educational achievement.

- **Exacerbation of Existing Disparities:** The digital divide in education can exacerbate existing disparities, particularly in developing countries. Pfeffer highlights the persistence of educational inequality across countries (Pfeffer, 2008). The lack of access and efficient use of technology to support education may further widen the gap between privileged and disadvantaged students, perpetuating socioeconomic disparities. The Knowledge Gap Theory complements these ideas, suggesting that ICTs can widen knowledge gaps between socioeconomic groups (Tichenor, Donohu and Olien, 1970). The Knowledge Gap Theory suggests that individuals with greater access to information and technology will be better equipped to acquire and apply knowledge effectively. Consequently, the lack of access to and efficient use of technology in education, particularly in developing countries, not only perpetuates existing disparities but also hampers the ability of disadvantaged students to bridge the knowledge gap, potentially leading to long-term economic and educational inequalities. Addressing this issue is paramount for ensuring that all students, regardless of their socio-economic background, can access the opportunities and resources they need to thrive in the digital era.

3.6 Digital Related Divide and Computer-based Test

In the digital age, technology plays an increasingly significant role in education (AlAdwani and AlFadley, 2022; Tesfamicael, 2022). Traditional pencil-and-paper tests are gradually being replaced by computer-based tests (CBTs), which offer several advantages such as automated scoring, immediate feedback, and adaptability (Safaruddin *et al.*, 2021; Mulyawansyah, Umar and Jaya, 2022). However, the transition to CBTs has also revealed a persistent issue: the digital-related individual differences (Mcdonald, 2002). The digital divide may significantly impact students' performance in computer-based exams. To excel in these assessments, students require a certain level of digital literacy and access to reliable technology. When computer-based exams become the exclusive mode of assessment, students lacking access to technology may face substantial disadvantages. For instance, those unfamiliar with digital tools and platforms may struggle to navigate the exam software, which impedes their test-taking speed (Goldberg and Pedulla, 2002). Furthermore, slow or unstable Internet connections may lead to delays and interruptions during the exam, resulting in frustration. Moreover, students without access to technology are unable to practice or prepare for computerised exams effectively. These challenges can harm student achievement and impact their future prospects associated with CBT.

The research on the impact of digital literacy/perceptions and test performance does not provide a conclusive result. While some have found no relationship between students' computer experience and CBT performance, others negate the findings or are inconclusive. Therefore, there is a need for further studies to investigate the relationship between digital literacy/perceptions and CBT performance in digitally divided countries, especially in Nigeria, where CBT is used for large-scale high-stake university entrance examinations. The three primary digital-related differences that may influence students' performance in CBT are computer experience, computer anxiety, and computer altitude (Mcdonald, 2002; Weir *et al.*, 2007; Chan, Bax and Weir, 2018). These three phenomena are discussed in detail below.

3.6.1 Computer Familiarity and Student Performance

Numerous studies have investigated the intricate relationship between test-takers' computer experience and their performance in computerised exams. The implications of this relationship are critical, as they can influence the fairness and effectiveness of CBT (Bugbee, 1996; Mcdonald, 2002). However, computer familiarity varies both internationally and within nations.

One of the central factors that influence the effect of computer experience on CBT performance is the availability and use of digital technologies at home and in educational institutions. Notably, a comparative international study conducted among countries participating in the Programme for International Student Assessment (PISA) highlights a striking divergence in digital technology accessibility and utilisation. According to data from the Organization for Economic Co-operation and Development (OECD) in 2015, the majority of OECD nations had computers in nearly every household, with some having more than one computer (OECD, 2015). A mere 4% of 15-year-old students hailed from families without computers, while 43% of households have three or more computers. Yet, these averages belie pronounced variations in computer access. For instance, the dichotomy between Denmark and Mexico: a striking 99% of Danish students enjoy computer access at home, whereas a stark 42% of their Mexican counterparts lack such access, with the Mexican percentage not accounting for 15-year-olds not enrolled in school. The digital divide is similarly glaring in Indonesia, where a staggering three-quarters (74%) of pupils lack home computer access. Furthermore, when evaluating the availability of school computers, the disparities persist. In some places, such as Tunisia, there are 53 students for every school computer, while the OECD average is 4.7. These disparities underscore unequal access to technology across countries, which may hold significant implications in computer-based testing.

Many researchers have studied how familiarity with and the ability to use computers can moderate examinees' performance in computerised tests. The examinee's level of computer literacy is frequently mentioned as a factor that may influence the CBT mode in several studies that look at the similarities and differences

between CBT and traditional test modes. Moreover, when computer familiarity is not a moderating factor that may impact the student's test performance, the examinee typically has similar computer exposure. Hence, computer familiarity is not considered a factor affecting the student's test performance. For instance, students who participated in research conducted by Akdemir and Oguz (2008) completed departmental computer courses. These students are expected to have adequate computer proficiency needed to navigate and successfully complete CBT.

Studies have underscored the substantial impact of prior computer knowledge on a candidate's performance in CBT. For example, a study conducted by (Ahlan, Atanda and Isah, 2012) surveyed undergraduate students at a Nigerian university and found that owning a personal computer correlated positively with higher levels of academic achievement. Moreover, the research of (Goldberg and Pedulla, 2002; Zou and Chen, 2016; Shirzad and Shirzad, 2017) collectively supports the notion that greater prior computer expertise leads to superior CBT performance. For instance, Goldberg and Pedulla (2002) investigated the relationship between computer familiarity and test-taker performance across different sections of the GRE, including editorially controlled CBT, uncontrolled CBT, and PPT. In this study, 222 undergraduate students were randomly assigned to complete either the test's verbal reasoning, quantitative reasoning, or analytical component using one of these testing modes. The results revealed that PPT group participants outperformed uncontrolled CBT group participants across all components. In contrast, the control group excelled in the analytical subtest compared to the uncontrolled CBT group. Furthermore, the study unveiled a significant advantage for those comfortable with computers in the analytical and quantitative subtests. Other studies have also shown that CBT mathematics tests are significantly more challenging than paper-administered ones for those with limited computer skills (Bennett *et al.*, 2008). Students with extensive computer experience were able to answer questions at a considerably faster rate than their less-experienced peers, potentially creating a disadvantage for the latter group. While beneficial for those well-versed in computer usage, this specific advantage might pose challenges for students with limited computer experience, as it places them at a potential disadvantage in CBT environments.

In a study with a similar focus, Zou and Chen (2016) explored how different test modes affected examinees taking an English Language exam, particularly those with varying levels of computer experience, by examining both the cognitive writing process and the resulting writing scores. This investigation involved 216 students who were asked to complete a computer familiarity questionnaire. Their responses to this questionnaire served as a basis for categorising them into one of three distinct levels of computer expertise: low, medium, or high. The students were then presented with a combination of CBT and paper-based comprehension assessments, with data recorded regarding their computer-mediated cognitive processes. The findings of this study revealed that students performed notably better when taking PBT than CBT. Additionally, a positive correlation emerged between the level of familiarity with CBT and an increase in the mean score. Notably, examinees with limited computer backgrounds experienced the most significant score disparities when CBT was compared to those who underwent testing via PBT. However, it's essential to emphasise that computer familiarity did not substantially influence the cognitive processes associated with writing. Regardless of the test mode, examinees demonstrated an ability to develop ideas effectively. The researchers postulated that individuals who were less at ease with computers might face challenges in organising their thoughts effectively in a computer-based environment, which could account for the lower scores observed in CBT among this group.

In a different study conducted by Shirzad and Shirzad in 2017, the utilisation of computers in second-language testing came under scrutiny. This research aimed to discern any potential correlations between candidates' computer literacy and their performance on the TOEFL digitalised test, specifically comparing it with traditional paper-based exams. The study relied on the respondents' frequency of computer usage to categorise them into two distinct groups. The "low computer literacy" group consisted of individuals who rarely used computers, while the "high computer literacy" group encompassed those who engaged with computers for at least two hours daily. The findings of this investigation underscore that factors beyond linguistic capabilities influence examination performance. In this context, familiarity with computers emerged as a significant determinant of candidates' writing prowess during the exams.

Those with a higher level of computer literacy demonstrated superior writing skills compared to their less computer-savvy counterparts. However, no substantial differences were observed when assessing performance in paper-based exams. These results provided some suggestive insights: participants who lack proficiency in computer usage may find themselves disproportionately allocating their cognitive resources and mental capacity to interact with the computer interface. This diversion of attention from the subject matter of the examination could hamper their ability to perform to their fullest potential in language tests, consequently leading to a decline in the quality of their written responses.

A study by Maguire et al. (2010) also indicated that students tend to perform more favourably in computerised tests when they have substantial familiarity and computer proficiency. This study's primary objective was to assess whether there existed a noteworthy disparity in the test scores between two groups of students: one subjected to computerised proctored assessments and the other to proctored classroom assessments employing traditional PBT methods. Notably, both groups received identical sets of questions. The participants for this research project were drawn randomly from a pool of 179 undergraduates enrolled in an intermediate accounting course at a university. Out of this cohort, 43 students completed all their assessments using CBT, while 92 students opted for the conventional pencil-and-paper approach. Importantly, all students attended the same class, regardless of the evaluation method employed. Upon conducting correlation analysis, a striking pattern emerged: students who exclusively undertook CBT scored significantly higher on average compared to their peers who exclusively utilised pencil and paper. This observation prompted the research team to posit a hypothesis – that this disparity could be attributed to students' increased comfort and familiarity with interacting via computer interfaces, which, in turn, could enhance their overall test performance.

On the contrary, a study by Chan, Bax, and Weir 2018 failed to establish a substantial correlation between participants' computer experience or familiarity and their performance in CBT. This research delved into students' performance in high-stakes writing examinations, comparing their experiences in traditional PPT and CBT

settings. A comprehensive computer familiarity questionnaire was administered to garner insights into the participants' computer usage, familiarity, perceived skill, and interest. Surprisingly, the study's findings revealed no significant disparity in the performance of test-takers who had experienced CBT and PPT. It is important to note that these participants had prior experience with computers. Consequently, they generally exhibited a positive disposition towards computer use and showed a preference for CBT. However, a pertinent revelation emerged from the study—there was a positive correlation between test performance and three specific computer familiarity variables: the ability to use a computer at a public library, the amount of time devoted to computer-based word processing, and the capacity to immerse oneself in computer tasks without noticing the passage of time. This implies that candidates who approach the CBT exam without adequate familiarity with these key aspects may experience diminished performance.

Similarly, a study conducted by Yu and Iwashita in 2021 reported no noteworthy difference when comparing performance in Paper-Based Testing (PBT) and CBT. In this research, PBT and CBT tests were administered to undergraduate students who were randomly divided into two groups, one for CBT and the other for paper-based testing (PBT), each group of 46 students. Data regarding computer familiarity was collected through both quantitative and qualitative methods. The findings disclosed that test scores in CBT and PBT were strikingly similar. Two facets of computer familiarity emerged as positively linked to test scores: the comfort level when reading on a screen and the ability to remain engrossed in computer tasks without tracking time.

It's worth noting that various other studies, including those by Clariana and Wallace (2002) and Hosseini, Abidin, and Baghdarnia (2014), also failed to identify a substantial relationship between test-takers' computer experience or familiarity and their performance in CBT. These results, while understandable given the comparable levels of familiarity in the sampled population, may not be directly applicable to countries like Nigeria, where significant disparities in technology access persist.

3.6.2 Computer Anxiety and Computer-based Test Performance

Performance in assessments is one of individuals' most significant sources of stress (West and Sweeting, 2003; Journault *et al.*, 2022). Test anxiety, irrespective of test mode, is a form of anxiety that emerges in anticipation, during and after assessments (Lowe, 2021). It involves feelings of apprehension, nervousness, and tension that can interfere with an individual's test. Test anxiety manifests in various ways, encompassing components like worrisome thoughts (intrusive concerns about failure), emotional responses (elevated heart rate and physiological reactions), and off-task behaviours (like procrastination and activities unrelated to the exam (Journault *et al.*, 2022).

While test anxiety in itself can be quite distressing, it takes on a distinct dimension when assessments are administered via computer-based test (CBT) methods (Stricker, Wilder and Rock, 2004; Lee *et al.*, 2022). The adoption of CBT introduces a layer of technological interface and unfamiliarity into the test-taking process, which can give rise to computer-based test anxiety (Mcdonald, 2002; Lee *et al.*, 2022). Computer anxiety, often described as an undue fear that obstructs a person's ability to interact with a computer, can lead to computer avoidance and heightened state anxiety, thereby affecting the efficient completion of simple computer tasks (Howard, 1987). Computer anxiety causes heightened computer avoidance and state anxiety, leading to slower completion of simple tasks on the computer (Mahar, Henderson and Deane, 1997). This computer-related anxiety, also known as computerphobia, tends to manifest in three distinct ways, with a common thread of negative attitudes towards technology: a reluctance to engage with computer technology, experiencing physiological symptoms of anxiety or terror, and the emergence of anger or frustration as a result of underlying dissatisfaction (Chou, 2003).

In the ever-evolving landscape of education and assessment, the impact of CBT on examinees' experiences and performance has been a subject of considerable interest and scrutiny. As technology becomes increasingly integrated into various aspects of our lives, it is essential to understand how individuals' comfort and familiarity with computers can shape their acceptance of CBTs and, ultimately, their test outcomes. A

study conducted by (Stricker, Wilder and Rock, 2004) found that computer anxiety significantly influences examinee acceptance of CBTs. Anxious examinees may even opt to avoid CBTs entirely if alternative testing methods are available. Moreover, individuals with high computer anxiety may be consumed by negative thoughts and experience physiological reactions, such as sweating, headaches, increased blood pressure, and nausea, which can adversely affect their performance in computerised tests (Balogun and Olanrewaju, 2016).

The extensive body of research on computer anxiety in the literature highlights several factors that may influence computer anxiety, including age, gender, other anxieties, personality traits, and an individual's professional background (Achim and Kassim, 2015). However, studies show a variant relationship between various demographic characteristics and computer anxiety. For instance, studies have investigated the relationship between age and computer anxiety, but the review revealed mixed findings. Powell's comprehensive literature review from 1990 to 2009 found an equal number of studies that reported a positive relationship between age and computer anxiety and those that did not establish a significant relationship (Powell, 2013).

Also, literature on the relationship between gender and computer anxiety revealed varying outcomes. Several studies report males having less anxiety towards computers than females (Bozionelos, 1996; Durndell and Haag, 2002; Chou, 2003). However, (Dyck and Smither, 1994; Cazan, Cocoradə and Maican, 2016; Nwagwu and Adebayo, 2016) found no significant difference in computer anxiety between males and females. Interestingly, (King, Bond and Blandford, 2002) reported conflicting findings in the same study. The study investigated the relationship between 3 classes of students (Grades 7,9 and 11) and their gender and computer anxiety. Even though females were generally less anxious than males, the individual computer anxiety levels of the students based on their classes revealed more detailed information. Females were more anxious in the lowest class of the three; the middle class showed no significant difference in anxiety between the two genders; and in the highest class, male students were most anxious. The study suggests a possible reason for this difference is that females have

become familiar with and confident using the computer over time, while males may perceive the computer as “uncool”.

Computer anxiety has also been linked to computer familiarity, as prior experience with computers can significantly impact anxiety levels (Ray and Minch, 1990; Shermis and Lombard, 1998; Beckers and Schmidt, 2001). Factors such as PC ownership, early exposure to computers, perceived computer proficiency, and the frequency of computer use have all been associated with anxiety (Korobili, Togia and Malliari, 2010). Powell’s literature review, covering the period from 1990 to 2009, revealed that computer familiarity is the most frequently explored factor related to computer anxiety, with 80% of the surveyed articles indicating a negative correlation between computer familiarity and computer anxiety (Powell, 2013). For example, a study by (Al-Jabri and Al-Khaldi, 1997) examined the computer-related perspectives of undergraduate students in a Saudi Arabian university. The findings demonstrated that computer expertise, accessibility, and personal computer ownership significantly impacted individuals’ computer-related anxiety and confidence. Notably, the correlation between computer confidence and the number of computer-related courses taken was positively associated, while its impact on computer anxiety was relatively small. Additionally, the study showed that GPA positively influenced computer confidence but did not significantly impact computer anxiety. Similarly, a more recent study by Cazan, Cocoradə, and Maican in 2016 investigated the associations between computer and internet anxiety, computer self-efficacy, and various demographic characteristics in Romania. The results indicated that individuals with low computer self-efficacy were more likely to experience computer anxiety. Furthermore, previous education in computer science had a direct negative effect on both computer anxiety and internet anxiety, with statistically significant differences observed among participants enrolled in different levels of education and study programs, particularly in the fields of science and humanities (Cazan, Cocoradə and Maican, 2016).

However, it’s important to note that not all studies have found a significant relationship between computer familiarity and computer anxiety. For instance, a study by (Durndell and Lightbody, 1993) found that computer anxiety had not decreased in

the past decade despite the widespread availability of computers. Similarly, a study by (Todman and Lawrenson, 1992) found no link between prior computer experience and computer anxiety among university and school students. Furthermore, qualitative exposure to computers has been identified as a critical determinant of computer anxiety. (Nwangwu, Obi and Ogwu, 2014; Balogun and Olanrewaju, 2016) investigate factors that contribute to computerised test anxiety among Nigerian undergraduate students. These studies found that computer efficacy plays a significant role in computer anxiety levels, indicating that students with higher computer efficacy tend to experience lower levels of anxiety. This highlights the importance of students gaining quality exposure to computers before taking CBTs, as it can enhance their computer efficacy and subsequently reduce CBT-related anxiety (Nwangwu, Obi and Ogwu, 2014; Balogun and Olanrewaju, 2016).

In addition to computer familiarity and efficacy, unexpected disruptions during CBT can heighten anxiety among test-takers. Situations such as power interruptions, computer peripheral malfunctions, loss of internet connectivity, or computer freezing can lead to increased anxiety among examinees. Adequate preparation of candidates and the implementation of effective risk mitigation plans are essential for reducing the impact of such disruptions on examinees (Mcdonald, 2002). A study by Adenuga and Mbarika in 2019 investigated the effects of technical support in mitigating computer anxiety during CBT and found that technical support reduced computer anxiety among examinees. Ensuring stability and control during CBT is crucial for promoting test acceptance and fairness (Mcdonald, 2002).

Moreover, studies have shown that computer anxiety is significantly related to test performance. For example, a study by Lu and colleagues in 2016 evaluated the effect of computer efficacy, test anxiety, and training satisfaction on the attitude and performance of examinees in computerised adaptive exams. The findings indicated a negative correlation between test anxiety and test performance. Similarly, in a study by (Shaheen *et al.*, 2022), students with higher anxiety levels achieved lower test scores, though the difference was not statistically significant. Furthermore, a study by Kolagari and colleagues in 2018 examined the relationship between test anxiety and students'

performance in both CBT and PBT (Kolagari *et al.*, 2018). The results revealed that students exhibited similar anxiety levels in both traditional and computerised test modes, with no statistically significant differences in performance between the two modes.

In conclusion, the existing literature on computer anxiety suggests that demographic differences and prior computer experience may influence anxiety during CBT, which can subsequently impact test performance. Consequently, this study investigates these factors as potential determinants of student performance and their overall experience when taking a high-stakes CBT university entrance examination in Nigeria.

3.6.3 Computer Attitude and Computer-based Test Performance

Attitudes toward computers encompass individuals' feelings and beliefs about computer technology (Laguna and Babcock, 2000). These attitudes are often shaped by past experiences and the associated feelings of confidence or anxiety (Mcdonald, 2002). Understanding these attitudes is crucial for the development of computer skills (Kay, 1993). Over time, researchers have established a strong correlation between attitudes toward computers and computer use in studies of technological adoption (Teo, 2008; Korobili, Togia and Malliari, 2010). Various demographic variables, including geographical location, parental support, and English language proficiency, can influence individuals' attitudes toward computers (Alothman, Robertson and Michaelson, 2017). Reducing computer anxiety and fostering positive computer attitudes is vital, as these factors can significantly impact performance and motivation in CBT (Mccroskey, 1970; Chu and Spires, 1991).

Due to its advantages, examinees may exhibit positive attitudes toward a particular examination mode. For instance, a study by (Ebimgbo, Igwe and Okafor, 2021) assessed the perceived effectiveness of CBT for large classrooms among Nigerian university undergraduates. The findings revealed that students generally held a positive attitude toward computer-based assessments, as they reduced stress, minimised issues with missing scripts, and curbed examination malpractices. Notably,

the students' academic discipline and proficiency in computer skills influenced their opinions regarding the efficacy of computer-based test examinations for large courses. Improved test quality was also found to enhance students' attitudes toward CBT. In a study by (Wibowo *et al.*, 2016), academic staff and students in an Australian university expressed their opinions on CBT. While students reported encountering issues during computerised assessments, such as difficulties in navigating the exam interface, technological glitches, and malfunctions, both students and staff displayed enthusiasm for the potential of e-exams if the e-exam system was upgraded. However, a portion of the students felt unprepared for e-tests, as they were accustomed to paper-based exams and believed that CBT could be cumbersome and anxiety-inducing, potentially affecting their scores.

Experience with CBT can significantly influence test-takers' attitudes toward this mode of assessment. In a study by (Pawasauskas, Matson and Youssef, 2014), the transition from traditional test formats to CBT in a university setting was evaluated. Pre-test and post-test questionnaires were administered to investigate staff and students' perceptions regarding CBT adoption. The results indicated that students initially harboured reluctance toward CBT, but their attitudes improved after they had experience with it. Seventy-five per cent of the students responded positively to the adoption of CBT. Furthermore, 85% viewed the integration of technology in education positively, and 87.5% reported comfort in using CBT software after its implementation. Another study by (Deutsch *et al.*, 2012) investigated the potential shift in students' attitudes after taking a web-based mock test. The findings revealed that experiencing CBT, such as through a mock exam, was positively related to improved attitudes toward CBT. However, students remained concerned about the impact of technical issues during CBT on their performance.

Notably, students' attitudes toward CBT can significantly impact their performance in CBT. A study by (Stricker, Wilder and Rock, 2004) found that opinions regarding the computer-based TOEFL were significantly associated with testing performance in three nations. These findings were particularly remarkable since the computer-based TOEFL typically revealed test results to test-takers before they

expressed their opinions on the exam, allowing score feedback to influence reported sentiments. Furthermore, attitudes toward the computer-based TOEFL had some association with opinions about admission exams, computer anxiety, and test anxiety. However, computer familiarity did not significantly influence attitudes toward the computer-based TOEFL/IELTS.

In contrast, other studies, including those by (Vispoel, Boo and Bleiler, 2001; Ebrahimi, Toroujeni and Shahbazi, 2019; Yu and Iwashita, 2021), found that test-takers scores were statistically identical for PBT and CBT modes. Furthermore, they observed no significant association between attitudes toward CBT and actual CBT performance. Intriguingly, some students preferred a particular exam mode while performing better in the other mode. For example, a study by (Hosseini *et al.*, 2014) compared students' performance and attitudes in English comprehension CBT and PPT. Students had a more positive attitude toward CBT but performed better in PPT. This outcome was largely attributed to CBT's advantages, such as ease of use. The study suggested the need to regulate factors affecting CBT and PPT test performance to ensure fairness and equivalency between the two testing modes.

These findings underscore the importance of considering test-takers' attitudes toward computer-based testing when implementing such computerised assessment methods. Understanding the factors that contribute to positive or negative attitudes can inform the design and implementation of CBTs, ensuring they address the concerns of individuals who may harbour reservations or anxieties toward this mode of examination. By promoting a positive attitude and addressing perceived disadvantages, educational institutions can facilitate a smoother transition to computer-based testing and enhance the overall testing experience for examinees.

3.7 Chapter Summary

This chapter presents the findings from a narrative literature review. This was conducted to provide a general overview of computer-based assessment, its types and generations, and its advantages. Furthermore, we discussed divide-divide, types, digital-divide in Nigeria and its potential impact on education. Also, we identified the key digital-related individual attributes that may impede the equivalence of PBT and CBT examinations. Lastly, studies with related objectives were discussed, along with their results.

The literature review identified computer familiarity/experience/proficiency, computer anxiety and computer attitude as the key digital-related individual differences that may affect candidates' performance in CBT. However, there is a gap in the literature on investigating these three attributes on the performance of candidates from grossly digitally divided societies in high-stakes computerised tests. This research intends to contribute to the literature by examining how computer experience, anxiety, and attitude affect candidates' performance in high-stake CBTs in Nigeria. Furthermore, this research investigates how candidates' experience during high-stakes CBT influences their attitude and anxiety about CBT.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter discusses the methodology used to answer the research questions of this study. Nigeria students taking the computerised Unified Tertiary Matriculation Examination (UTME)- an essential examination for prospective students of Nigerian tertiary institutions, is used as a case study. Therefore, data collection was centred around this examination. This study aims to investigate individual digital differences among secondary school students taking large-scale high-stake CBT university entrance examinations in Nigeria and its effects on their performance on the test. In order to adequately investigate this, we used mixed methods in this study. The quantitative study was used to collect data on respondents' perceptions about their computer familiarity/proficiency level, CBT anxiety and attitude before and after UTME. Furthermore, a qualitative study was conducted to know the examinees' experience during UTME and its influence on their attitudes and anxiety about CBT. Therefore, the following are the research questions of this study:

1. Are UTME examinees' computer familiarity/experience differences based on their school type (public versus private) and location (urban versus rural)?
2. What is the relationship between aspects of computer familiarity/experience of UTME examinee and their test score?
3. Are there differences among UTME examinees' anxiety about PBT and CBT (before and after UTME) based on their school type (public versus private) and location (urban versus rural)?
4. Does the test takers' attitude to CBT before and after UTME predict their scores in UTME?
5. Are there differences among UTME examinees' attitudes to PBT and CBT (before and after UTME) based on their school type (public versus private) and location (urban versus rural)?

6. Does test takers' attitude to CBTs before and after UTME predict their scores in UTME?
7. What can we learn about students' attitudes and anxieties towards the CBT version of the UTME?

4.2 Justification of Mixed Methodology

This research employed mixed methods: a quantitative and qualitative study. The following are the primary justifications for doing a mixed methods study: (1) triangulation (combining qualitative and quantitative data to solve a research problem); (2) embedded (using either quantitative or qualitative data to answer a research question within a largely qualitative or quantitative study); (3) explanatory (using qualitative data to explain or expatiate quantitative results); and (4) exploratory (using quantitative data to test and explain a relationship discovered in qualitative research) (Creswell and Clark, 2007; Venkatesh, Brown and Hillol, 2013). Therefore, mixed-methods design techniques provide an effective framework for information researcher researchers to provide more strong insights from their study and, as a result, contribute to theory and practices (Venkatesh, Brown and Hillol, 2013).

This study used a two-stage sequential explanatory design, with the quantitative phase first followed by the qualitative phase (McKim, 2017). A sequential explanatory, mixed method design was employed so that the qualitative results might help provide a better understanding of quantitative results. The initial quantitative study helped gather information from many students relatively quickly, which was used to identify patterns and trends that informed the interview process. Furthermore, the precedence of quantitative study allowed for familiarisation with the research stakeholders and aided the qualitative processes.

The quantitative study answers this study's first six research questions (see research questions in section 4.1). It investigated candidates' computer familiarity, paper/CBT anxiety and attitude prior to the UTME and CBT attitude and anxiety after the exam. Also, the relationships between computer familiarity, CBT attitude and anxiety, and performance during CBT were also established. Consequently, a

qualitative study was conducted to understand these students' experiences in more depth and gain insight into the factors that contribute to their attitudes and anxiety (see research questions in section 4.1). Conducting a qualitative study helps us explore each participant's perspectives and uncover similar themes and patterns throughout their experiences while taking UTME. We also examine if qualitative research might help explain certain intriguing quantitative results.

4.3 Quantitative Study

Quantitative research quantifies information and assesses the prevalence of different viewpoints and attitudes in a selected sample (Park and Park, 2016). Furthermore, quantitative data analysis allows researchers to collect data from a larger sample in a shorter time. Data collection from larger samples results in better accuracy when generalising research findings on the overall population. Similarly, quantitative research does not require close observation or direct contact to be valid. Therefore, it gives respondents ample time and privacy to fill in their responses. The privacy characteristics of quantitative studies improve participant participation and the accuracy of information.

Furthermore, quantitative research methods have been used in research related to this current study. (Clariana and Wallace, 2002; Goldberg and Pedulla, 2002; Stricker, Wilder and Rock, 2004; Hosseini, Abidin and Baghdarnia, 2014; Pawasauskas, Matson and Youssef, 2014; Lu *et al.*, 2016; Zou and Chen, 2016; Brunfaut, Harding and Batty, 2018) uses a quantitative questionnaire to collect information about one or more of the metrics (computer familiarity, CBT attitudes and CBT anxiety) used in this study. For example (Pawasauskas, Matson and Youssef, 2014) in their study deployed a pre and posted CBT questionnaire to study students' and staff's attitudes towards transitioning from PPT to CBT at the University of Rhode Island. (Chan, Bax and Weir, 2018) use a quantitative questionnaire to investigate the relationship between computer familiarity on the test score of IELTS academic writing tasks in paper-based and computer-administered tests.

Similarly, (Stricker, Wilder and Rock, 2004) use a quantitative questionnaire to investigate the attitude of non-native speakers of the English language towards computer-based TOEFL. Also, (Shermis and Lombard, 1998) use a quantitative questionnaire to gather information about examinees' computer anxiety levels to obtain its predictive capabilities of test takers' performance. Given the advantages of quantitative research mentioned above and its validated use in similar studies, this study will use quantitative research approaches to achieve the first three research objectives and answer the first six research questions.

4.3.1 Data Collection

This research is interested in the students taking UTME in Nigeria. Data were collected about candidates' computer familiarity, paper/CBT anxiety and paper/CBT attitude prior to the test and CBT attitude and anxiety after the exam. We are interested in participants with varying levels of computer exposure. The targeted research sample is readily accessible in Nigerian senior secondary schools. Students in their final year in secondary school who intend to proceed to tertiary studies after secondary school education are expected to pass UTME.

Digital technology available in Nigerian secondary schools is minimal; hence, this research used paper-pencil questionnaires to collect quantitative data from recipients. Data collection was carried out in two phases (see Figure 4.1 for the quantitative data collection timeline). In the first phase of the research, consented participants' are issued the first paper-based questionnaire within two weeks before the 2021 UTME test date. This questionnaire collected data on respondents' perceptions about their level of computer familiarity/proficiency, paper/CBT anxiety and paper/CBT attitude. In the second phase of the research, a follow-up paper-based questionnaire was administered to collect data about their CBT anxiety and CBT attitude within two weeks post-UTME period. The pre-examination and post-examination questionnaires were served to the same set of students. Both questionnaires were compared for each respondent to capture any shift in participants' opinions on CBT anxiety and attitude post-UTME. Both questionnaires were served to respondents in their respective schools by the researcher. After completion of the questionnaires, they

were returned within a day. Only participants that completed the pre-examination and post-examination questionnaires were retained for analysis.

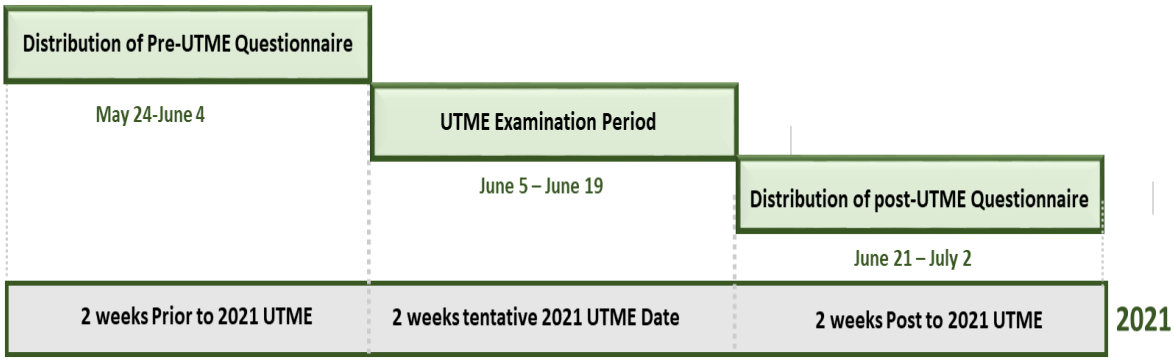


Figure 4. 1: Data Collection timeline

4.3.2 Sample Selection

This research was interested in 2021 UTME examinees in Nigeria with varying computer familiarity/proficiency levels. Therefore, data were collected from both public and private senior secondary schools in rural and urban locations. Private schools in Nigeria are generally more costly than publicly owned schools. Therefore, the type of schools students attend in Nigeria mainly depends on the student's socio-economic class. Similarly, the central city (state capital) is generally more developed and has better access to technology than other regions of most states in Nigeria (Okunola, Rowley and Johnson, 2017a). Consequently, it is expected that collecting a sample from private and public secondary schools and students in urban (state capital) and rural areas (outside the state capital) will result in respondents with varying computer proficiency levels.

Given the time and resources available for this study, research participants were only recruited from twenty (20) schools in Osun state, Nigeria. The sample of interest (2021 UTME examinees) was accessed in public and private senior secondary. A list of private and public secondary schools in Osun state was collected from the Directorate of Schools and Academic Planning, Osun state ministry of education, Osun state secretariat, Abere, Osogbo.

There are 394 and 934 accredited public and private secondary schools in Osun state (as obtained from the Osun state ministry of education in March 2020). Schools were grouped based on their locations urban (state capital) and rural (outside state capital). The school types are private and state government-owned schools. The categorisation generated four groups of respondents in 4 classes of schools: 1. Private schools in the urban region (state capital) 2. Government schools in the urban region (state capital) 3. Private schools in the rural region 4. Government schools in the rural region. Five schools were selected from each group randomly using a randomizing website- www.randomizer.org. Research participants were recruited from these twenty schools only.

Principals of these schools were approached to seek permission to administer questionnaires to the 2021 UTME examinee. All schools gave verbal consent that the students could be approached and requested to participate in the study. Afterwards, a school representative (often the principal) introduces the researcher to final-year secondary school students registered to take UTME in 2021. The researcher briefly introduces herself and the research. Subsequently, students are supplied with information sheets; containing information about the researcher, the research and how data will be collected, stored and processed (see Appendix A.1). Students interested in the study are supplied with a consent form to validate their interest (see Appendix A.2).

4.3.3 Participants

For a participant to qualify for the study, he/she must be at least 16 years old, registered in one of the accredited senior secondary schools in Osun and for 2021 UTME.

4.3.4 Quantitative Data Instrument Design

The questionnaire used in this study is designed to collect data on respondents' computer familiarity, paper/CBT anxiety and paper/CBT attitude before taking UTME and the last two metrics post-UTME. The survey was composed of four main sections: demographical data, computer familiarity/ experience, paper/CBT Anxiety Rating Scale, and paper/CBT Attitudes Scale. The questionnaire was developed using three significant steps discussed below:

a. **First Questionnaire Design:** The computer familiarity, paper/CBT anxiety and paper/CBT attitude questionnaire was formulated by adapting questions from a similar study (Stricker, Wilder and Rock, 2004; Adenuga and Mbarika, 2019) to a neutral and simplified format suitable for the target respondents. The survey was composed of four main sections: demographical data, computer familiarity/ experience, Paper/CBT Anxiety and Attitudes Rating Scale. Demographic information included the respondent's location (urban or rural) and school type (public or privately owned). The computer familiarity/experience section asked questions about previous computer use, access to a computer at home, access to a computer in school, previous CBT participation and the official UTME mock exam. The four CBT anxiety-adapted sub-scales are Comfort/Discomfort, Concentration/Distraction, Fearfulness/Confidence, and Calmness/Nervousness. The anxiety subscales are used to collect respondent attitudes about PPT and CBT (before and after UTME). Furthermore, the adapted 6-item test mode attitude includes: "Test perception", "Ease/Difficulty of test", "Confidence/Doubt of test score", "Mode Relationship with Test Performance", and "Test Preference". These items collect respondents' attitudes to PPT and CBT (before and after UTME).

The drafts of the pre-examination and post-examination questionnaires were shown to two information science professors who have experience with questionnaire design and evaluation to critique the following three factors-

- Appropriateness of questionnaire to measure the desired construct
- Clarity of statement and appropriateness of questionnaire for desired respondents
- The appropriateness of questions, the length, and the number of questions for desired respondents.

Necessary corrections and adjustments were made to the questionnaire based on the feedback given by the two experts.

b. Secondary Validation of Questionnaire

The corrections were effected based on the experts' suggestions and comments. This stage is repeated until all research stakeholders are satisfied with the questionnaire quality.

c. **Preliminary Test by Prospective UTME Examinee**

Before finalising the questionnaire, volunteers who were prospective 2021 UTME candidates examined it. Twenty of them completed the questionnaire to determine the average length of time it took and the clarity and understanding of the questions. Some questions were revised based on respondents' input to increase clarity and comprehension of the questions posed in the questionnaire. For example, respondents were asked: "If I could choose, I would rather take my assessment using this assessment mode: [ ] PBT [ ] Neutral [ ] CBT. Please give reason(s)?". From the responses given, such as *'PBT allows me to express myself better*, respondents assume that PBT contains an essay section (that allows them to write and discuss as desired and that CBT is only a multi-choice examination. However, both CBT and PBT are intended to be multi-choice questions. Therefore, the question was rephrased to indicate that both examinations are multi-choice in the context of this research. The question was changed to: "If I could choose, I would rather take my multi-choice assessment using this assessment mode". Furthermore, the average time for filling out the questionnaire was known (10-15 minutes), and the information was included in the final information sheet distributed to respondents. See Appendix A.3 and A.4 for the final pre-exam and post-exam questionnaires.

4.3.5 Questionnaire Reliability Test

A questionnaire reliability test is an essential aspect of quantitative questionnaire design. It is the measure of internal consistency and accuracy of a designed questionnaire. Internal consistency is the extent to which items adequately measure a particular construct (Cortina, 1993; Kottner and Streiner, 2010). Therefore, a questionnaire can be consistent if the same traits are measured by all items included. A standard measure used to test for internal consistency of questionnaire construct is the

Cronbach alpha, which is widely used to measure the reliability of their questionnaire. For example, Cronbach's alpha measures the interrelationship between item scores in a questionnaire measuring the same constructs (Cortina, 1993). The alpha value ranges between 0 and 1: value 0 denotes no correlation among the item scores, and value 1 denotes a perfect correlation. Therefore, the closer the Cronbach value is to 1, the higher the correlation between questionnaire items and the level of internal consistency. The Cronbach alpha value is acceptable when the value is greater than .70.

In this research, the Cronbach value for attitude to PBT, attitude to CBT, anxiety to PBT and anxiety to CBT are .72, .75, .72 and .73, respectively. All the Cronbach values fall into the range of acceptable Cronbach alpha values; therefore, the questionnaire items have good internal consistency.

Table 5.9: Results of Cronbach alpha on Computer-based test attitude and Computer-based test anxiety Questionnaire

Metrics and Corresponding Items	**Mean**	**Std. Deviation**	**Cronbach Alpha**
Attitude to Paper-based Test			**0.721**
Perception of Test	3.80	.994	
Ease of Test	3.70	.971	
Experience with Test	3.69	.938	
Confidence in Test Score	3.79	1.132	
Mode Relationship with Performance	3.82	.970	
Attitude to Computer-based Test (before-UTME)			**0.730**
Perception of Test	3.71	.979	
Ease of Test	3.42	1.040	
Experience with Test	3.62	.972	
Confidence in Test Score	3.55	1.202	
Mode Relationship with Performance	3.71	.969	

Attitude to Computer-based Test (after-UTME)			**0.754**
Perception of Test	3.44	1.000	
Ease of Test	3.23	.955	
Experience with Test	3.37	.955	
Confidence in Test Score	2.71	1.341	
Mode Relationship with Performance	3.13	1.053	
The anxiety of Paper-based Test			**0.721**
Physical Comfort in Test	3.74	1.023	
Level of Concentration in Test	3.77	1.413	
Fearfulness in Test	3.83	.938	
Calmness during Test	3.83	.938	
The anxiety of Computer-based Tests (before-UTME)			**0.733**
Physical Comfort in Test	3.44	1.053	
Level of Concentration in Test	3.87	.990	
Fearfulness in Test	3.04	1.142	
Calmness during Test	3.49	.982	
The anxiety of Computer-based Tests (after-UTME)			**0.723**
Physical Comfort in Test	3.02	1.139	
Level of Concentration in Test	3.66	1.021	
Fearfulness in Test	3.17	1.117	
Calmness during Test	3.59	.995	

4.3.6 Ethical Approval

This research involves collecting data directly from humans. Hence, this research must comply with the university's ethical requirements, the data protection act and general data protection regulations. The research applied and was granted ethical approval by

the Department of Computer and Information Sciences, University of Strathclyde. The ethics approval ID is 1389 for reference purposes.

4.3.7 Quantitative Analysis Method

The independent variables are *computer familiarity, paper/CBT anxiety and paper/CBT attitude*. The dependent variable is the student's *UTME score (performance)*. Lastly, the mediating variable is the *student's school (public/rural)* and *location (rural/urban).* Therefore, this study uses the following student categories: rural-public, rural-private, urban-public and urban-private. Data Analysis was conducted using SPPS and graphically represented using Microsoft Excel.

Descriptive analysis was used to answer the first research question (R1): *Are UTME examinees' computer familiarity/experience differences based on their school type (public versus private) and location (urban versus rural)?* The variation in the percentage of the five categories of students' previous computer use, access to computers in school, access to a computer at home, voluntary participation in paid MOCK UTME and previous CBT experience.

To answer the second research question, R2: *what is the relationship between aspects of computer familiarity/experience of UTME examinee and their test score?,* Mann-Whitney U test and Spearman's rank-order correlation coefficient test were used. Mann-Whitney U test was used to find the relationship between 4 aspects of computer familiarity/experience (previous computer use, access to computer at home, access to computer in school, voluntary participation in UTME) and respondents' UTME score. Mann-Whitney U test if there is a significant difference in the score of students with each aspect of computer familiarity/experience and those who do not have familiarity/experience. Mann-Whitney U test is a non-parametric test applied to compare the differences between two independent variables where the dependent variable is ordinal or continuous, and the assumption(s) of the parametric alternative is violated. The following assumptions of the Mann-Whitney U test must be fulfilled for the test to be correctly applied. 1. The dependent variable should be ordinal or continuous. 2. The independent variable should be a categorical variable comprising

two independent groups. 3. The observations should be independent 4. The independent and dependent variables are not normally distributed. The significant asymptotic value, p-value, determines whether a significant relationship exists between the two variables. A p-value less than 0.05 shows a statistically significant relationship between the two variables. When a significant statistical relationship exists, the null hypothesis is rejected.

Furthermore, Spearman's rank-order correlation coefficient was used to test if there is a significant relationship between the number of times a student has taken CBTs and UTME scores. Spearman's rank-order correlation measure is a non-parametric test used to test the strength of association between two variables. The following assumptions of Spearman's rank-order correlation measure must be fulfilled for the test to be correctly applied. 1. At least one variable has to be of categorical or ordinal type 2. The two variables are paired values 3. The relationship between the two variables is monotonic. After the test application, the p-value observed determines whether a significant association exists between the two variables. A p-value less than 0.05 shows a statistically significant relationship between the two variables. When a significant statistical relationship exists, the null hypothesis is rejected. Furthermore, the Spearman's correlation coefficient, R_s, is used to determine the strength of the relationship between the variables. R_s value ranges between -1 and 1, denoting a perfectly negative association and positive association, respectively. While a value of 0 has no significant relationship between the two variables.

Research question three (R3): "*Are there differences among UTME examinees' anxiety to PPT and CBT (before and after UTME) based on their school type (public versus private) and location (urban versus rural)?"*, was answered using Kruskal Wallis Test and Mann-Whitney U Test. Kruskal Wallis Test was conducted to determine if there is a statistically significant difference in the anxiety of the four categories of students towards paper-based tests, CBT before UTME and CBT after UTME. One-way Kruskal-Wallis is a non-parametric test that can be used to determine if there are more groups that are significantly different from each other in a variable of interest. The test is correctly applied if the following assumptions are met: 1. The

dependent variable should be of continuous type 2. The Independent variable (the grouping variable) should not be related, and independent groups 3. each group should have at least five values. Where a significant difference exists based on the results of the Kruskal-Wallis test, Mann-Whitney U Test was used to determine the difference. The same procedure is used to answer research question three (R3) was used to answer research question five (R5): *Are there differences among UTME examinees' attitudes to PPT and CBT (before and after UTME) based on their school type (public versus private) and location (urban versus rural)?*.

Regression analysis was used to answer research question 4 (R4): *Does the test takers' attitude to CBT before and after UTME predict their score in UTME?* Regression analysis is used to estimate the relationship between a dependent variable Y and one or more independent variables X=[X1|…|Xp]. It can be used to model the long-term link between variables and evaluate the strength of the relationships between them. The mathematical representation of multiple linear regression is:

$$Y = a + bX1 + cX2 + dX3 + \ldots + \epsilon$$

Where: Y – Dependent variable, X1, X2, X3 – Independent (explanatory) variables, a – intercept, b, c, d – Slopes, ϵ – Residual (error).

The same procedure used to answer research question four (R4) was used to answer research question 6 (R6): *Does test takers' attitude to CBT before and after UTME predict their score in UTME?*

4.4 Qualitative Research Method

The quantitative study established that CBT anxiety and attitude appear to be moderately positive among all categories of participants. A qualitative study was conducted to understand these students' experiences in more depth and gain insight into the factors that contribute to their attitudes and anxiety established in the quantitative results. Conducting a qualitative study allows us to explore the perspectives of each participant and identify common themes and patterns across their experiences while taking UTME. We also examine if qualitative research might help explain certain

intriguing quantitative results. The research question for the qualitative research investigation is:

"What can we learn about students' attitudes and anxieties towards the CBT version of the UTME?"

4.4.1 Qualitative Research Design

This study adopted a phenomenological qualitative design to understand the experiences of high-stakes CBT takers in Nigeria and gain a more nuanced understanding of the factors contributing to their CBT attitude and anxiety established in the quantitative study. It is a qualitative research design often used to understand people experiencing the same phenomenon (Burrows *et al.*, 2021). Subsequently, shared attitudes such as "happiness and fear" among people of interest can be identified (Creswell *et al.*, 2007). Information is drawn from participants' statements, characteristics, and interpretations rather than the researchers' interpretation of the phenomenon. Thereby allowing us to explore participants' experiences in-depth, gain a more nuanced understanding of the factors contributing to a phenomenon, and identify patterns across the participants' experiences.

Phenomenological design often adopts interviews as a method of data collection. The open-ended questions can allow the participants to discuss their perceptions and personal circumstances in detail and from a personal experiential point of view. In addition, conversation during data collection can move to an unpredictable course into important areas not previously included in the research, adding more value to the information collected from the study participants (Gorman and Clayton, 2004). Therefore, by adopting the phenomenological qualitative design method, we hope to understand various students' experiences and understand the "what" and the "how" of students' attitudes and anxiety during high-stake CBT examinations in Nigeria (Burrows *et al.*, 2021).

4.4.2 Participants and Sampling Techniques

This research previously collected quantitative data from students of 5 rural-public, five rural-private, five urban-public and five urban-private schools in Osun state, Nigeria,

under ethics approval (Study 1, Chapter 5, ethics application Id: 1389). Two schools from each of the four categories were selected for this study based on the convenience of obtaining qualitative data. Administrative heads of each of these schools were approached for an extension of the previous study and to seek permission to recruit UTME examinees for interviews. All four schools gave verbal consent that the students could be approached and requested to participate in this study.

Purposeful sampling was employed to select participants of interest. To qualify for this study, the participants must be above 16, have registered in one of these selected secondary schools, and have sat for the 2022 UTME examination. This final study's participants were recruited according to the first come, first served principle. Data was collected from each participant category until the interviews contained repetitious expressions, the saturation point (Boddy, 2016). A total of 50 students participated in the study. A different set of students in some of the previously sampled schools during the quantitative study was used for the qualitative study. This is because students in the final year of secondary school were used for the study. By the time of qualitative data collection, a year later, previously surveyed students had graduated.

4.4.3 Procedure

The researcher was physically present in all eight schools to introduce the study and collect data. Once access is given to final-year students in each school, the purpose of the research, the interview process and their respective rights were adequately explained to the students. In addition, the participants were provided with information sheets (*see Appendix B1*) containing detailed information about the research, the researcher, and the rights of the participants. They were also encouraged to ask questions about the study and procedure. Candidates interested in the research were given a consent form (*see Appendix B2*) to express their informed consent. The interview script is included in Appendix B3).

The interview process lasted for about 6-10 minutes. The interviews lasted less time than anticipated. This may be because students were questioned around two months after taking the UTME, and their memories of the event are still rather vivid.

Consequently, the majority of their responses are to-the-point. In addition, the majority of the students that participated in the familiarisation session had never engaged in a qualitative study, which may have indirectly influenced the length of the interviews. All interviews conducted were audio-recorded using two mobile phones. The researcher conducted all interviews from 23rd June 2022 to 18th July 2022. The interviews were focused on the respondents' experience, attitude and anxiety towards CBT. The researcher manually transcribed all interviews since the interviews were not very long, and manual transcription enabled the researcher to conduct an overview study of the participants' responses. Some samples of the transcript of interviews conducted with respondents are shown in Appendix B5.

4.4.4 Data Processing

Thematic analysis (TA) was used to analyse the data and identify common themes and patterns across the participants' experiences (transcribed interview responses) since it offers a robust and adaptable methodological approach for examining qualitative data (Braun, V., & Clarke, 2006). Braun and Clarke first proposed reflexive TA in 2006 (Braun, V., & Clarke, 2006); it is an iterative coding technique in which codes are dynamically created, allowing codes to evolve in each cycle until there is convergence which may subsequently be related to bigger theoretical or conceptual issues. The connection is inverted in much qualitative research. For example, discourse analysis (DA) or grounded theory analysis requires the researcher to be conversant with sophisticated theoretical viewpoints. Knowing the viewpoints is critical because it influences what the researcher understands from the data, how they code and analyse it, and the interpretations of the analysis. Conversely, TA is only a method of data analysis rather than a means of performing qualitative research. TA's flexibility and transparency are notable advantages, and it is commonly used in Information systems research (Attard and Coulson, 2012; Mo and Coulson, 2014; Gleeson, Craswell and Jones, 2021).

Thematic analysis is very beneficial when looking for subjective information like a participant's experiences, ideas, and beliefs (Braun and Clarke, 2012). Since the research question of this study is interested in assessing participants' experiences, views,

and opinions about computer-based UTME, thematic analysis is a possible approach. There are six stages in reflexive TA (Braun, V., & Clarke, 2006), which are shown in Figure 4.2 Below. The data analysis processes were completed using Nvivo 12 (available at https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home), a specialised qualitative analysis software. After initial data processing (coding) by the primary researcher, two information science professors reviewed the results of each data processing step to increase the reliability and dependability of the processes (Günaydin and Arguvanli Çoban, 2021).

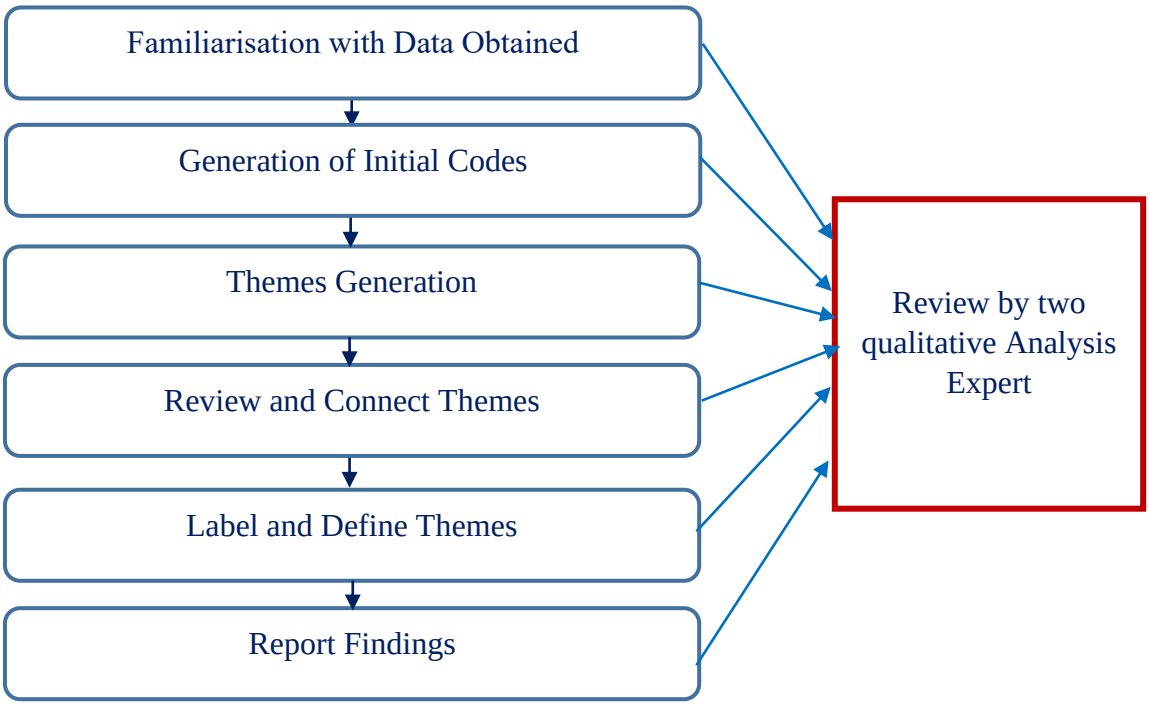


Figure 4. 2: Stages of reflective TA

- **Familiarisation with Obtained Data:** this is done by carefully reading through the transcript. In this study, the researcher transcribed the audio recording manually, which helped familiarise with the data obtained and note important points referred to through the analysis process.
- **Generation of Initial Codes:** this identifies relevant thoughts (including words, phrases, sentences, and sections contained in the transcript) that answer the research question. These identified relevant thoughts were used to generate

initial codes. Figure 4.3 below shows a snippet of some codes generated from interviews with respondent 7.

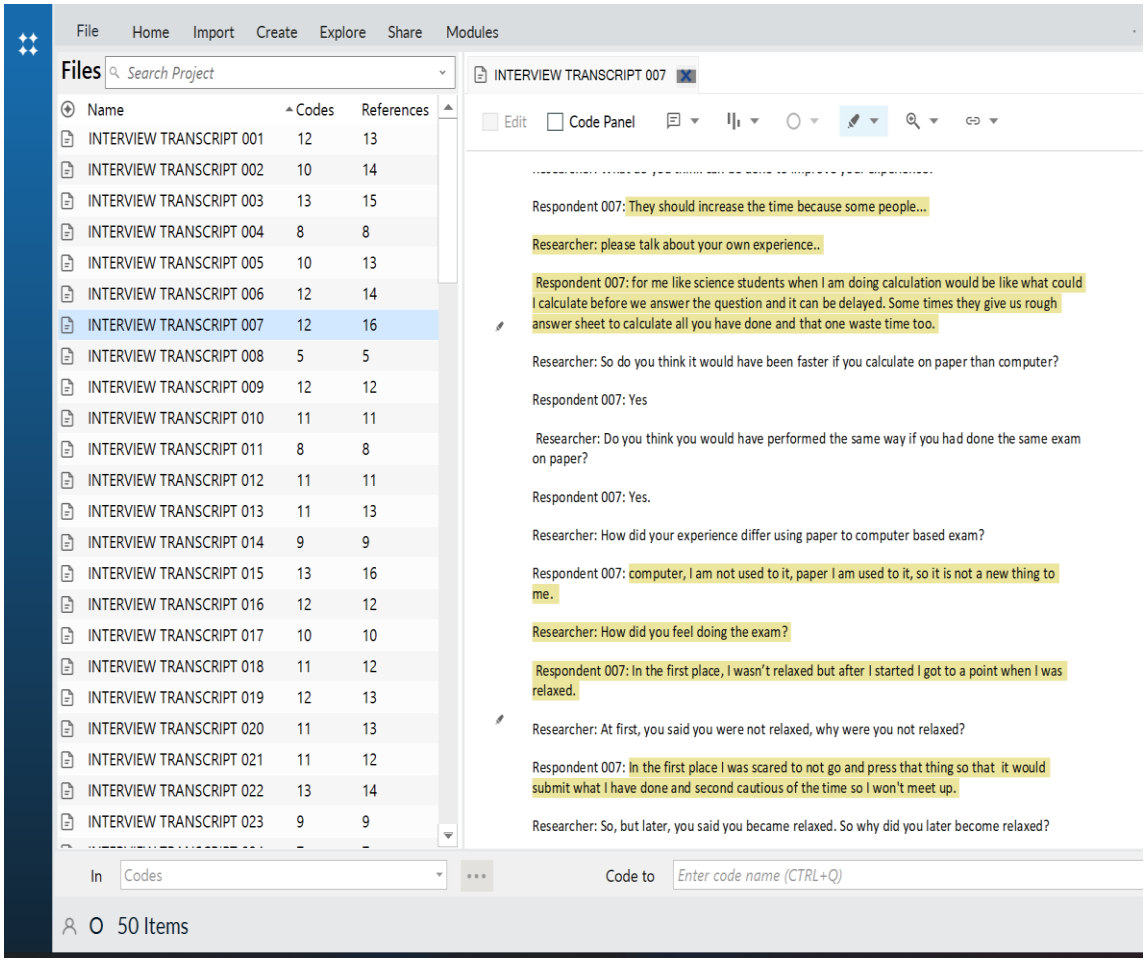


Figure 4. 3: Snippet of some Codes generated from Respondent 7.

- **Themes Generation:** the previously generated codes were examined to identify similar ideas, and the similar codes were grouped to form themes. For example, Figure 4.4 shows examples of codes that have been grouped because they share similar sentiments.

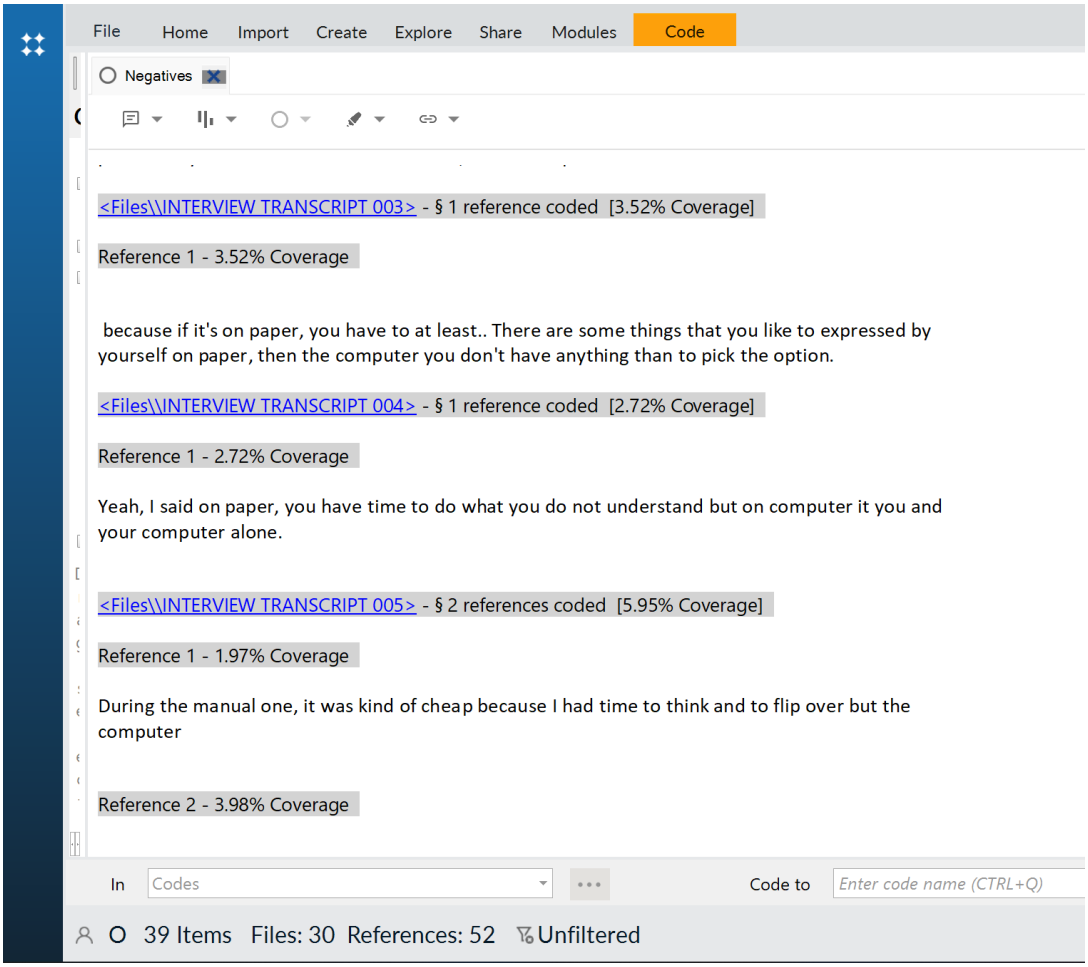


Figure 4. 4: Snippet of some Codes grouped together because they share similar Sentiments.

- **Review and Connect Themes:** Read through the transcript again to ensure each theme is distinct. Then, connection and hierarchy were established among generated themes. By going through the review process, new themes that might have been overlooked are identified to ensure themes are accurate and relevant summaries of the data collected. Some relationships between themes were simply identified since the interviewers made explicit mention of them; the remaining influences were identified by comparing comments from several interviewees.
- **Label and Define Themes:** Give each theme appropriate names and a suitable definition. This study also uses a thematic map to illustrate the interconnection between themes and sub-themes. The final themes and sub-themes are included in Chapter 6, section 6.1.

- **Reporting Findings:** this includes a detailed explanation of the processes followed in conducting the thematic analysis, a description of the data and the incorporation of relevant data to support the assertions and information derived from the data. The findings of the qualitative study are reported in Chapter 6.

4.3.5 Ethical Consideration

The University's Ethics Committee gave the study approval (No. 1879). Before the interviews, participants were made aware of the purpose of the study, the need to record digitally, and the confidentiality of personal data. Each student gave their verbal and written agreement. It was clear that all information would be used for scientific research and that privacy concerns would be respected.

CHAPTER 5

A SURVEY-BASED STUDY OF UTME CANDIDATES' COMPUTER-RELATED INDIVIDUAL DIFFERENCES AND THEIR RELATIONSHIP WITH TEST PERFORMANCE

5.1 Introduction

This chapter presents the statistical data analysis of data collected through questionnaires from the UTME examinee. The chapter includes a descriptive analysis of the correspondent information and their responses. Furthermore, relationships among the variables are presented. Analysis has been grouped based on the research questions to enhance clarity.

5.2 Descriptive Statistics: Respondents' School and Location

The moderating variable in this study is school location and school type. Hence, respondents are grouped based on their school type: public or private, and the location of their schools: urban (located in the state capital) or rural (located outside the state capital). Table 5.1 summarises the number of respondents who completed survey responses in this study's pre-UTME and post-UTME stages of data collection. Four hundred seventy-nine (479) respondents completed the pre-examination questionnaires. Most of the respondents were from privately owned schools in the rural settlement of the state. The fewest respondents were students in public secondary schools in the state's rural areas. The low response rate is because only a few students in public secondary schools living in rural regions registered to participate in UTME. The number of students registered for UTME at a government-owned school in a rural area was 0; for another school in the same category was 2 out of 50 students. In the second phase of data collection, 402 respondents completed post-examination questionnaires. Only respondents with completed pre-examination and post-examination questionnaires were included in this study. Hence, the final sample used in this study consists of 402 respondents.

Table 5. 1: Responses from Data Collection Phases based Respondents' school type and location

PRE-EXAM QUESTIONNAIRE		POST-EXAM QUESTIONNAIRE		
School Type /Location	**No of Participants**	**School Type/Location**	**No of Participants**	**%**
Public/Rural	83	Public/Rural	71	18%
Public/Urban	100	Public/Urban	76	19%
Private/Rural	188	Private/Rural	166	41%
Private/Urban	108	Private/Urban	89	22%
Total	**479**	**Total**	**402**	**100%**

5.3 UTME Examinee Computer Familiarity/Experience Variations Among Respondent Categories (R1)

Table 5.2 and Table 5.3 summarises the variation in computer familiarity and usage among students in the four respondents' categories in this study: rural-public, rural-private, urban-public and urban-private. Table 5.2 presents the percentage of respondents' positive or negative responses to whether they had previously used a computer before UTME, had access to a computer at school and home, and participated in the paid voluntary UTME mock examination organised by JAMB. Table 5.3 present the frequency of previous CBT participation before UTME based on the four respondents categories in this study.

Table 5. 2: Computer Familiarity Variation Across School Locations and Types

			Respondents Classification: School Location/Type			
Aspects of Computer Familiarity/Experience	**Response**	**Total R (%)**	**Rural/ Public**	**Rural/ Private**	**Urban/ Public**	**Urban/ Private**
Previous Computer Usage	No	16 (4%)	10 (14%)	0	6 (8%)	0
	Yes	386 (96%)	61 (86%)	166 (100%)	70 (92%)	89 (100%)
Access to Computer in School	No	63 (16%)	36 (51%)	5 (3%)	20 (26%)	2 (2%)
	Yes	339 (84%)	35(49%)	161(97%)	56 (74%)	87 (98%)
Access to Computer at Home	No	75 (19%)	23 (32%)	20 (12%)	23 (30%)	9 (10%)
	Yes	327 (81%)	48 (68%)	146 (88%)	53 (70%)	80 (90%)
Voluntary participation in paid mock UTME	No	251 (62%)	38 (54%)	132 (80%)	44 (58%)	37 (42%)
	Yes	151 (38%)	33 (46%)	34 (20%)	32 (42%)	52 (58%)

Table 5. 3: Frequency of CBT participation Across School Locations and Types

Frequency of Previous CBT	**Frequency (%)**	**Respondents Classification: School Location/Type**			
		Rural/ Public (%)	**Rural/ Private**	**Urban/ Public**	**Urban/ Private**
Never	76 (19%)	28 (39%)	12 (7%)	17 (22%)	19 (21%)
1 time	36 (9%)	7 (10%)	16 (10%)	6 (8%)	7 (8%)
2-5 times	130 (32%)	22 (31%)	56 (34%)	27 (36%)	25 (28%)
6-10 times	55 (14%)	3 (4%)	36 (22%)	6 (8%)	10 (11%)
> 10 times	105 (26%)	11 (15%)	46 (28%)	20 (26%)	28 (31%)

5.3.1 Previous Computer Use

Ninety-Six per cent (386/402) of the respondents have previously used a computer before the UTME. All the respondents that have not used a computer before UTME are from public schools in rural and urban locations. Approximately 14% and 9% of the respondent from rural-public and urban-public schools, respectively, have not used a computer before UTME. The difference in previous computer use is pronounced when comparing public versus private secondary schools rather than students in rural and urban locations. It was expected that most students in their final year in public and private registered secondary schools would register for UTME. However, it was found that a significant percentage of students in government-owned schools do not write

UTME. Some public-owned secondary schools in rural settlements have 2 out of 50 students in their final year sitting for UTME. Since this research only collected data from students registered for 2021 UTME, many students in government-owned schools, especially rural ones, were excluded from the study. Consequently, it may be that a significant percentage of excluded students may not have used a computer before or have very low computer proficiency. An assumption supported by existing literature; digital illiteracy is common among people from poor backgrounds and rural settlements (Okunola, Rowley and Johnson, 2017a).

5.3.2 Access to Computers in School

Sixteen per cent of respondents do not have access to a computer in school. Students from public schools have the highest percentage of students with no access to a computer at school. 51% and 26% of students from rural-public and urban-public schools do not have access to a computer at school. On the contrary, 84% and 98% of respondents from rural-private and urban-private schools have access to a computer in schools. There is a 25% and 14% difference in the percentage of respondents with access to a computer at home within a school type in different locations: (rural-*public* versus urban-*public*) and (rural-*private* versus urban-*private)* schools, respectively. However, there is a more significant percentage difference when access to a computer at home is compared across inter-school types within the same location: (rural-*public* versus rural-*private*) and (urban-*public* versus urban-*private),* with a difference of 33% and 72%. As a result, the difference in access to a computer at home is more apparent when comparing private and public schools rather than rural and urban locales.

5.3.3 Access to Computer at Home

Nineteen per cent of respondents do not have access to a computer at home. Students from public schools have the highest percentage of students with no access to a computer at home; 32% and 30% of students from rural-public and urban-public schools do not have access to a computer at home. On the contrary, 88% and 90% of respondents from rural-private and urban-private schools have access to a computer at home. There is just a 2% difference in the percentage of respondents with access to a computer at

home within a school type in different locations: (rural-*public* versus urban-*public*) and (rural-*private* versus urban-*private* schools, respectively). However, there is a more significant difference in percentage when access to a computer at home is compared across inter-school types within the same location: (rural-*public* versus rural-*private*) and (urban-*public* versus urban-*private),* with a difference of 56% and 60%. The most noteworthy difference in access to a computer at home is, therefore, more evident when comparing private and public schools as opposed to rural and urban areas.

5.3.4 Voluntary Participation in Paid MOCK UTME

Only 38% of respondents participated in the voluntary mock examination organised by JAMB, the UTME officiating organisation. Respondents from urban-public schools have the highest percentage of enrolment in voluntary mock UTME at 58%. The respondents with the least percentage of enrolment in the voluntary mock exam are respondents from rural-private schools at 20%. Respondents from rural-public and urban-public schools have 46% and 42% enrolment in the mock exam, respectively. The higher percentage recorded could be because of easy access and proximity to mock examination centers available to city test-takers. However, students in public schools have a higher participation rate in voluntary paid mock examinations organised by JAMB than students in private schools. Lower access to computers by students in public schools possibly prompted the increase in participation of the students in the mock exam. Participating in a mock examination allows candidates to practice the exam in a real-life environment before the actual test.

5.3.5 Previous CBT Experience

Thirty-nine per cent of respondents in rural-public schools have never done a CBT before UTME, and only 19% of the students have done CBT 6 or more times before UTME. However, 34%, 50%, and 42% of students from urban-public, rural private and urban-private schools have done CBT at least six times before UTME. 22%, 7% and 21% of students from urban-public, rural private and urban-private schools, respectively, have never done CBT before UTME. Most test takers who have never taken a CBT exam before the UTME are from rural public schools.

5.3.6 Decision on Hypothesis $H_0$1

In conclusion, there are significant variations in the UTME examinees' computer familiarity/ experience based on their school type and location. Therefore, the null hypothesis, $H_0$1, is rejected.

> $H_0$1: There is no significant difference in UTME examinees' computer familiarity/ experience based on their school type and location.

5.4 Aspects of Computer Familiarity Relationship with UTME Performance (R2)

Mann-Whitney U test was used to find the relationship between 4 aspects of computer familiarity/experience (previous computer use, access to computer at home, access to computer in school, voluntary participation in UTME) and respondents' UTME score. Mann-Whitney U examines whether there is a statistically significant difference between the UTME scores of students with each aspect of computer familiarity/experience and those without familiarity/experience. Table 5.4 summarises the results of the comparison. At a significance level of .05, the results show that students who previously used a computer and have access to a computer in school or at home have a statistically significant score than those that do not. However, there is no significant statistical difference in the UTME scores of students who took part in the official mock exam and those that did not.

Furthermore, Spearman's rank-order correlation coefficient was used to test if there is a significant relationship between the number of times a student has taken CBTs and UTME scores. Table 5.5 shows the average UTME score based on the number of times they participated in CBT before UTME. At a significant level of a=0.05, the result shows a significant relationship between the number of times a candidate has taken CBT and their CBT score at p=0.000. Furthermore, the estimated correlation coefficient ($R_{(s)}$) is .184. This $R_{(s)}$ shows a weak positive association between the two variables. Hence, this suggests that the more times someone has done a computer-administered test, the higher their UTME score. However, the pairwise comparison chart (Figure 5.1) showing the average UTME score of candidates based on the number of times they have

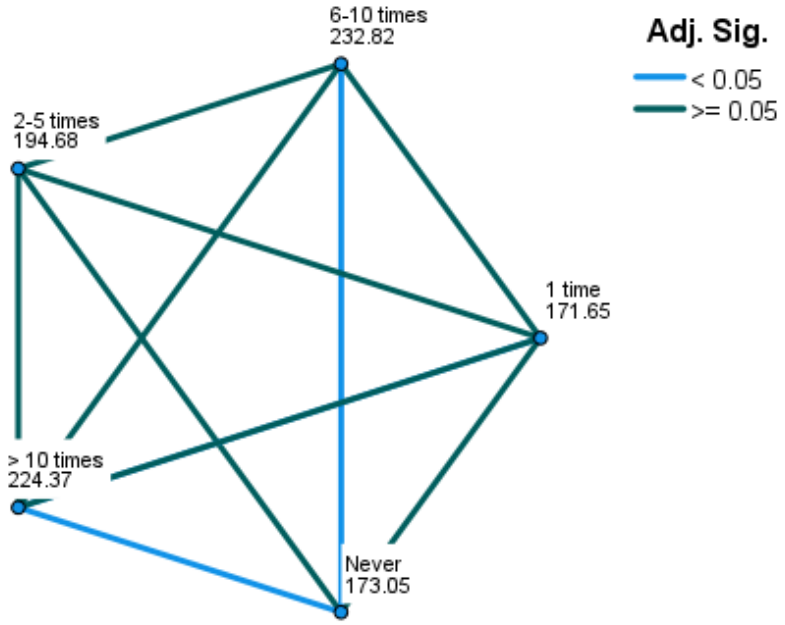
previously taken CBT reveals further information. The most significant difference is observed in the performance of students who had not done CBT before UTME and those that have done it at least six times.

Table 5. 4: Application of Mann-Whitney U test to Compare Aspects of Computer Familiarity/Experience Relationship with Test Score.

Aspects of Computer Familiarity/Experience		Min	Max	Mean	Mean Rank	Std.	Sig.[a]
Used computer before UTME	No (16)	138	218	171.8	155.6	25.7	.003
	Yes (386)	100	294	197.7	205.1	36.0	
Access to computer in school	No (61)	109	244	180.9	150.4	31.4	.000
	Yes (341)	100	294	199.2	210.6	36.0	
Access to computer at home	No (80)	107	289	181.2	149.8	33.0	.000
	Yes (322)	100	294	200.5	214.3	35.6	
Participation in official Mock UTME	No (251)	100	294	196.1	198.3	37.3	.486
	Yes (151)	109	290	197.7	206.7	33.6	
a. The significance level is .050.							

Table 5. 5: The average UTME score based on the number of times candidates participated in CBT before UTME

Frequency	Mean Score	Average Rank
0	188.5	173.5
1	186.1	171.7
2 to 5	193.6	194.7
6 to 10	207.9	232.8
>10	204.1	224.4



*each node shows the sample average rank of the number of previous CBT experience
*significance of .005

Figure 5. 1: Pairwise Comparisons of Frequency of Number of Previous CBT Experience

5.4.1 Decision on Hypothesis $H_0$2

In conclusion, a significant relationship exists between aspects of UTME examinees' computer familiarity/experience and their test scores. Therefore, the null hypothesis, $H_0$2, is rejected.

> $H_0$2: There is no significant relationship between aspects of UTME examinees' computer familiarity/experience and their test scores.

5.5 UTME Examinees' Computer Anxiety Variations (R3)

To answer the third research question (R3), we compared participants' anxiety about PBT and CBT (before and after UTME) modes for significant statistical differences. Afterwards, we compared the anxiety of the four categories of participants to each test mode for a significant difference.

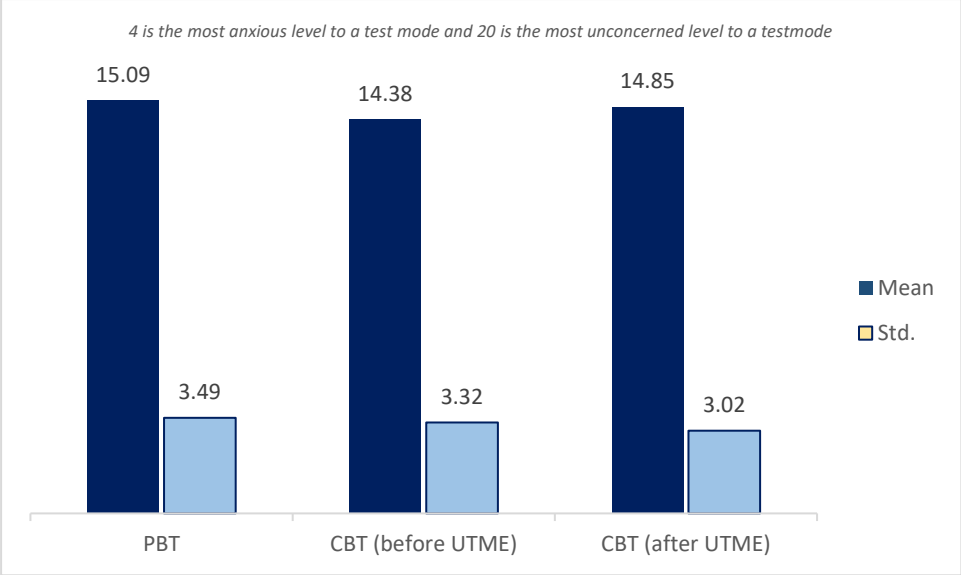
The four items of the test mode anxiety scale (Comfort/Discomfort, Concentration/Distraction, Fearfulness/Confidence, and Calmness/Nervousness) were

collected using five scales each. Therefore, to get a student's overall anxiety to a particular test mode, the score of the student's responses to each of the questionnaire items were added together. Therefore, the most anxious about a test mode is rank 4, and the least anxious about a test is rank 20. Furthermore, the minimum score of 4 is classified as "very anxious", 5-8 is "anxious", 9-12 is "neutral", 13-16 is "unconcerned", and 17-20 is "very unconcerned".

5.5.1 Anxiety of Students to Test Modes

This section discusses the test mode anxiety of students toward PBT and CBT (before and after UTME). The average PBT mode anxiety is 15.17, with a standard deviation of 3.10. The 15.17 value falls under the "unconcerned" overall anxiety classification. Furthermore, the average test mode anxiety students' CBT before UTME and after UTME are 13.84 and 13.45, respectively, with 3.12 and 3.16 standard deviations. Figure 5.2 shows the rank of the student's anxiety towards the test modes.

Like PBT, overall Anxiety toward CBT before and after CBT falls under the "unconcerned" anxiety range. However, students are least anxious about PBT, and anxiety about CBT increases after UTME. Therefore, the Wisconsin Signed Rank test was used to test if there is a significant difference between the overall Anxiety toward the test modes. The comparison results in Table 5.6 shows only a difference in students' overall anxiety about PBT when compared to CBT before UTME and CBT after UTME.



***there is a significant difference between students' anxiety about PBT, CBT (before UTME) and CBT (after UTME).*

Figure 5. 2: Students' Average Anxiety to Test Modes

Table 5. 6: Testing for Significant Differences between Students' Test Mode Anxiety

Comparison	Significance of Wisconsin Signed Rank Test (p-val.)	Decision
PBT Anxiety comparison with CBT Anxiety (before exam)	<.001	Significant difference
CBT Anxiety (before exam) comparison with CBT Anxiety (after exam)	.031	Significant difference
PBT Anxiety comparison with CBT Anxiety (after exam)	<.001	Significant difference

5.5.2 Anxiety of Categories of Students to Test Modes

Table 5.7 summarises the average anxiety of each category of students to test modes and their corresponding standard deviations. Kruskal Wallis Test was conducted to determine if there is a statistically significant difference in the anxiety of the four categories of students towards PBT and CBT (before UTME and after UTME)- *see Table 5.8 for results*. The result only shows a significant difference in the anxiety of the four categories of students towards CBT after UTME. Therefore, we compare the students' anxiety towards CBT after UTME among the respondents' categories using Mann-Whitney U Test and Table 5.9 summarises the results. The results show a

significant difference in the attitude of students from Rural-Public schools to other students in other categories.

Table 5. 7: Test Modes Anxiety Variation Among Respondents' Categories

Anxiety about Exam Type	Rural-Public		Rural-Private		Urban-Public		Urban-Private		Overall	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Paper	15.08	3.5	15.20	3.0	15.20	2.9	15.03	2.7	15.12	3.0
CBT before UTME	14.38	3.3	13.61	3.3	13.92	3.1	13.74	2.7	13.84	3.1
CBT after UTME	14.85	3.0	13.16	3.0	13.63	2.7	12.72	3.5	13.45	3.2

Table 5. 8: Kruskal Wallis Test To test Significant differences in Students' Anxiety to test modes

	Paper	CBT before UTME	CBT After UTME
Kruskal-Wallis H	.165	4.303	18.112
Asymp. Sig.	.983	.231	<.001

Table 5. 9: Mann-Whitney U test Comparing Anxiety of Students to CBT after UTME

Group Compared	Z score	Significance
Rural-Public vrs Rural-Private	-3.594	**.000**
Rural-Public vrs Urban-Public	-2.352	**.019**
Rural-Public vrs Urban-Private	-3.222	**.000**
Rural-Private vrs Urban-Public	-1.073	.283
Rural-Private vrs Urban-Private	-1.099	.272
Urban-Public vrs Urban-Private	-1.846	.065

5.5.3 Decision on Hypothesis $H_0$3

In conclusion, a significant difference exists in UTME examinees' anxiety about PBT and CBT based on their school type and location. Therefore, the null hypothesis, $H_0$3, is rejected.

> $H_0$3: There is no significant difference in UTME examinees' anxiety about PBT and CBT based on their school type and location.

5.6 Computer Anxiety Relationship with UTME Performance (R4)

Multiple regression analysis was conducted to examine whether aspects of students' anxiety towards CBT before UTME (see Table 5.10) and after UTME (see Table 5.11) predicted UTME scores. The independent variables used for the measurement were the four items of the test mode anxiety scale (Comfort/Discomfort, Concentration/Distraction, Fearfulness/Confidence, and Calmness/Nervousness). The ANOVA results show that the independent variables before UTME are not significant predictors of UTME score (Table 5.10), F (4, 397)= .673, p >.05. Furthermore, the results also indicated that each of the four independent variables: comfort/discomfort during the exam (β = .005, p > .05), concentration/distraction during the exam (β = .046, p > .05), fearfulness/confidence during the exam (β = .057, p > .05) and level of calmness/nervousness during the exam (β = -.081, p > .05) in the Pre-UTME anxiety questionnaire are not significant predictors of UTME score.

Similarly, the results of post-UTME anxiety regression analysis also showed that the independent variables after UTME does not predict UTME score (Table 5.11), F (4, 397)= .384, p >.05. Also, each of the four independent variables: comfort/discomfort during the exam (β = .034, p > .05), concentration/distraction during the exam (β = .008, p > .05), fearfulness/confidence during the exam (β = .044, p > .05) and level of calmness/nervousness during the exam (β = -.029, p > .05) are not significant predictors of UTME score.

Table 5. 10: Regression analysis of Aspects of CBT mode anxiety predicting test score before UTME

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	β		
(Constant)		194.432	8.946		21.735	<.001
CBT_Comfort/Discomfort		.171	2.040	.005	.084	.933
CBT_Focus/Distraction		1.667	2.018	.046	.826	.409
CBT_Fearful/Confidence		1.807	2.084	.057	.867	.386
CBT_Relaxed/Nervous		-2.949	2.294	-.081	-1.286	.199
a. Dependent Variable: UTME Score						

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3488.998	4	872.249	.673	.611[b]
	Residual	514643.313	397	1296.331		
	Total	518132.311	401			
a. **Dependent Variable:** UTME Score b. **Predictors:** (Constant), CBT_Comfort/Discomfort, Focus/Distraction, Fearful/Confidence, Relaxed/Nervous						

Table 5. 11: Regression analysis of Aspects of CBT mode anxiety predicting test score after UTME

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	β		
(Constant)		191.673	8.268		23.184	<.001
CBT_Comfort/Discomfort		1.073	1.865	.034	.575	.565
CBT_Focus/Distraction		.274	2.021	.008	.135	.892
CBT_Fearful/Confidence		1.408	1.930	.044	.730	.466
CBT_Relaxed/Nervous		-1.031	2.071	-.029	-.498	.619
a. Dependent Variable: UTME Score						

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1996.083	4	499.021	.384	.820[b]
	Residual	516136.228	397	1300.091		
	Total	518132.311	401			
a. **Dependent Variable:** UTME Score b. **Predictors:** (Constant), CBT_Comfort/Discomfort, Focus/Distraction, Fearful/Confidence, Relaxed/Nervous						

5.6.1 Decision on Hypothesis $H_0$4

In conclusion, there is no significant relationship between test takers' anxiety about CBT before and after UTME and their test scores. Therefore, the null hypothesis, $H_0$4, is accepted.

> $H_0$4: There is no significant relationship between test takers' anxiety about CBT before and after UTME and their test scores.

5.7 UTME Students' Computer Attitude Variations (R5)

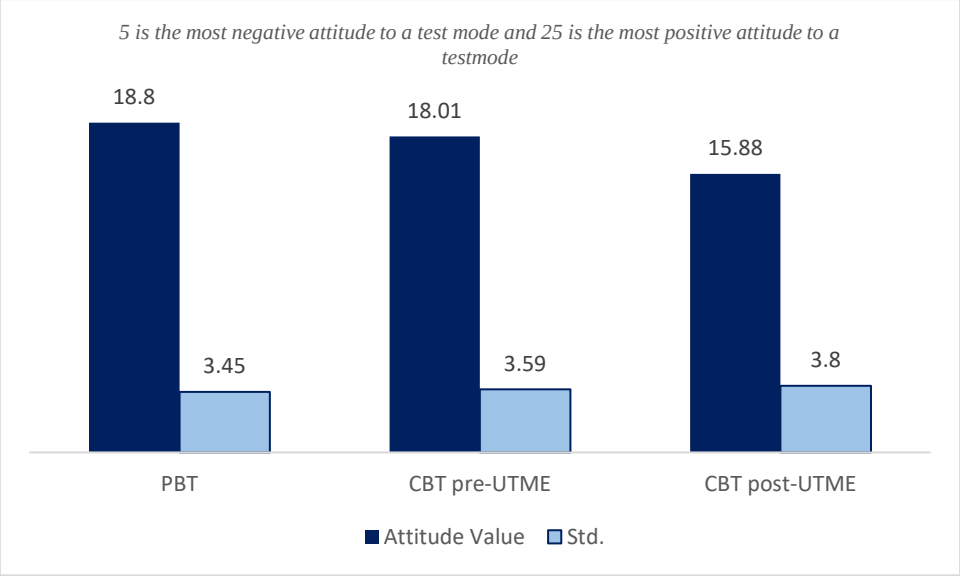
To answer the third research question (R5), we compared participants' attitudes to PBT and CBT (before and after UTME) modes for significant statistical differences. Afterwards, we compared the attitude of the four categories of participants to each test mode for a significant difference.

Students were asked to respond to 5 test mode attitudinal questions. The five items: "positive/negative perception of test", "ease/difficulty of test", "positive/negative experience with test", "confidence/distrust of test score", and "positive/negative-mode relationship with performance", were collected using five-level scales each. Students can rank each questionnaire item from 1 (most negative attitude) to 5 (most positive attitude). Therefore, to get a student's overall attitude to a particular test mode, the score of the student's response to each of the questionnaire items was added up. So the most negative attitude towards a test mode is ranked 5, and the best attitude towards a test is 25. Furthermore, the minimum score of 5 is classified as a "very negative attitude", 6-10 is a "negative attitude", 11-15 a "neutral attitude", 16-20 is a "positive attitude", and 21-25 is a "very positive attitude".

5.7.1 Attitude of Students to Test Modes

This section discusses the test mode attitudes of students toward PBT and CBT (before and after UTME)-*see Figure 5.3*. The average PBT mode attitude is 18.80, with a standard deviation of 3.45. The 18.80 value falls under the "positive" overall attitude classification. Furthermore, the average perspective of students' perception of CBT before UTME and after UTME are 18.01 and 15.88, respectively, with 3.59 and 3.80

standard deviations. Like PBT, the overall attitude toward CBT before and after CBT falls under the "positive" attitude range. When comparing the average overall attitude of the three test modes, the paper-based test has the highest value suggesting that students are most positive about PBT. Therefore, the Wisconsin Signed Rank test was used to test whether there is a significant difference in attitude toward the test modes. The comparison results in Table 5.12 show a significant difference between students' overall attitudes about PBT, CBT (before UTME) and CBT (after UTME). PBT ranked highest in favourable attitude and CBT after UTME rank the least.



***there are significant differences between rural-public students' attitudes to PBT, CBT (before UTME) and CBT (after UTME).*

Figure 5. 3: Students' Average Attitude to Test Modes

Table 5. 12: Testing for Significant Differences between Students' Test Mode Attitudes

Comparison	Significance of Wisconsin Signed Rank Test (p-val.)	Decision
PBT Attitude comparison with CBT Attitude (before exam)	<.001	Significant difference
CBT Attitude (before exam) comparison with CBT Attitude (after exam)	.000	Significant difference
PBT Attitude comparison with CBT Attitude (after exam)	.000	Significant difference

5.7.2 Attitude of Categories of Students to Test Modes

Table 5.13 summarises the average anxiety of each category of students to test modes and their corresponding standard deviations. Kruskal Wallis Test was conducted to determine if there is a statistically significant difference in the attitude of the four categories of students towards PBT and CBT (before UTME and after UTME)- *see Table 5.14 for results*. There is only a significant difference in the attitude of the four categories of students towards CBTs after UTME. Therefore, we compare students' attitudes to CBT after UTME among the school categories using Mann-Whitney U Test, Table 5.15. summarises the results. The results show a significant difference in the attitude of Rural-Public vrs Rural-private school, Rural-Public vrs Urban-Private, Rural-Private vrs Urban-Public and urban-Private vrs urban-public school respondents to CBT after UTME. Students in rural-public schools have the most positive attitude to CBT after UTME.

Table 5. 13: Test Modes Attitude Variation Among Respondents

Attitude to Exam Type	Rural-Public		Rural-Private		Urban-Public		Urban-Private		Overall	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Paper	18.59	3.2	19.23	3.7	18.68	3.4	19.03	3.0	18.80	3.4
CBT before UTME	18.07	3.4	18.09	3.6	17.84	3.5	17.94	3.8	18.01	3.5
CBT after UTME	17.15	3.3	16.20	3.7	14.84	4.3	15.17	3.5	15.88	3.8

Table 5. 14: Kruskal Wallis Test To test Significant differences in Students' Attitude to test modes.

	Paper	CBT before UTME	CBT After UTME
Kruskal-Wallis H	1.986	2.632	24.905
Asymp. Sig.	.575	.452	<.001

Table 5. 15: Mann-Whitney U test Comparing Attitudes of Students to CBT after UTME

Group Compared	Z score	Significance
Rural-Public vrs Rural-Private	-4.155	**.000**
Rural-Public vrs Urban-Public	-0.645	.519
Rural-Public vrs Urban-Private	-3.222	**.001**
Rural-Private vrs Urban-Public	-3.515	**.000**
Rural-Private vrs Urban-Private	-0.221	.825
Urban-Public vrs Urban-Private	-2.682	**.007**

5.7.3 Decision on Hypothesis $H_0$5

In conclusion, a significant difference exists in UTME examinees' attitudes to PBT and CBT based on their school type and location. Therefore, the null hypothesis, $H_0$5, is rejected.

> $H_0$5: There is no significant difference in UTME examinees' attitudes to PBT and CBT based on their school type and location.

5.8 Computer Attitude Relationship with UTME Performance (R6)

Multiple regression analysis was conducted to examine whether aspects of students' attitudes towards CBT before UTME (see Table 5.16) and after UTME (see Table 5.17) predicted UTME scores. The six items of the test mode attitude scale (positive/negative test perception-, ease/difficulty of the test, positive/negative experience with the test, confidence/distrust in test score, positive/negative mode relationship with test performance and preferred test mode) were the independent variables used for the measurement. The results of pre-UTME attitude regression analysis showed that the independent variables after UTME does not predict UTME score (Table 5.16), F (4, 397)= .693, p >.05. Also, the results indicated that all the six variables: positive/negative test perception (β = .684, p > .05), ease/difficulty of the test (β = .765, p > .05), positive/negative experience with the test (β = .852, p > .05), confidence/distrust in test score (β = .235, p > .05), positive/negative mode relationship with test performance (β = .885, p > .05) and preferred test mode (β = .751, p > .05) in the Pre-UTME attitude questionnaire are not significant predictors of UTME score.

Similarly, the results of post-UTME attitude regression analysis also showed that the independent variables after UTME does not predict UTME score (Table 5.17), F (4, 397)= 1.790, p >.05. Also, each of the six independent variables: positive/negative test perception (β = .450, p > .05), ease/difficulty of the test (β = .312, p > .05), positive/negative experience with the test (β = .591, p > .05), confidence/distrust in test score (β = .005, p > .05), positive/negative mode relationship with test performance (β = .260, p > .05) and preferred test mode (β = .724, p > .05) are not significant predictors of UTME score.

Table 5. 16: Regression Analysis of Aspects of CBT Mode Attitude Predicting Test Score before UTME

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	β		
1	(Constant)	179.778	9.596		18.735	<.001
	CBT_Positive/negative perception	.841	2.063	.023	.408	.684
	CBT_Ease/difficulty	.637	2.125	.018	.300	.765
	CBT_positive/negative experience	.436	2.337	.012	.186	.852
	CBT_Confidence/distrust of test score	2.063	1.734	.069	1.190	.235
	CBT_positive/negative mode relationship with test performance	.332	2.301	.009	.144	.885
	PreferredTestMode	.797	2.515	.017	.317	.751

a. Dependent Variable: UTME Score

ANOVAa

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	5395.979	6	899.330	.693	.656[b]
Residual	512736.332	395	1298.067		
Total	518132.311	401			

a. Dependent Variable: UTME Score

b. Predictors: (Constant), CBT_Positive/negative perception, CBT_Ease/difficulty, CBT_positive/negative experience, CBT_Confidence/distrust of test score, CBT_positive/negative mode relationship with test performance, Preferred Test Mode.

Table 5. 17: Regression Analysis of Aspects of CBT Mode Attitude Predicting Test Score after UTME

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	β		
1	(Constant)	190.052	8.745		21.732	<.001
	CBT_Positive/negative perception	1.743	2.304	.048	.757	.450
	CBT_Ease/difficulty	2.392	2.365	.064	1.011	.312
	CBT_positive/negative experience	-1.221	2.268	-.032	-.538	.591
	CBT_Confidence/distrust of test score	-4.443	1.557	-.166	-2.854	.005
	CBT_positive/negative mode relationship with test performance	2.392	2.122	.070	1.127	.260
	PreferredTestMode	.849	2.402	.018	.353	.724
a. Dependent Variable: UTME Score						

ANOVAa					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	13714.161	6	2285.693	1.790	.100[b]
Residual	504418.150	395	1277.008		
Total	518132.311	401			
a. Dependent Variable: UTME Score					
b. Predictors: (Constant), CBT_Positive/negative perception, CBT_Ease/difficulty, CBT_positive/negative experience, CBT_Confidence/distrust of test score, CBT_positive/negative mode relationship with test performance, Preferred Test Mode.					

5.8.1 Decision on Hypothesis $H_0$6

In conclusion, there is no significant relationship between test takers' attitudes to CBT before and after UTME and their test scores. Therefore, the null hypothesis, $H_0$6, is accepted.

> **$H_0$6**: There is no significant relationship between test takers' attitudes to CBT before and after UTME and their test scores.

5.9 Conclusion

The study's findings revealed significant variations in the access and use of computers among students in rural versus urban locations and students in public and private schools; better access and use of computers in private schools and urban locations. However, the disparity is more pronounced between students in public and private schools rather than those in rural and urban locations. Consequently, students in public-rural schools have the least access and experience with computers- 14% of them have not used a computer before, 51% of them do not have access to a computer in schools, 32% don't have access to a computer at home and 39% have not previously done CBT before UTME. This is in contracts with examinees in private-urban schools- 100% have used a computer before UTME, 98% have access to a computer in school, 90% have access to a computer at home, and 79% have done CBT before UTME at least once.

Results show that examinees who have used a computer before UTME, have access to a computer at school or home and have previously done CBT have a statistically significantly better UTME score than those who do not. When comparing the scores of students based on the number of times they had previously taken CBT before UTME: the most significant difference is observed in the performance of students who had not done CBT before UTME and those who did it at least six times. The implication of this is that the higher the access and experience of students to computers, the better they perform in UTME. The results are contrary to claims that computer familiarity has no significant impact on test performance (Clariana and Wallace, 2002; Akdemir and Oguz, 2008; Chan, Bax and Weir, 2018). However, it backs up earlier studies that show that students with better access to and experience with computers perform better (Mazzeo *et al.*, 1991; Clariana and Wallace, 2002; Goldberg and Pedulla, 2002; Ahlan, Atanda and Isah, 2012). Moreover, international CBT implementation guidelines recommend that students have significant exposure and practice with a computer before an exam is administered through a computer (International Test Commission, 2004; Thurlow *et al.*, 2010).

The CBT anxiety and attitude of examinees in all categories fall under the lower values of the “unconcerned” anxiety scale and “positive” attitudinal scales. Generally,

examinees have the least anxiety and the most positive attitude to the paper-administered test. Notably, the attitude and anxiety of students to CBT before UTME do not differ significantly. This results support the findings from a previous study where students residential location does not have a significant relationship with their anxiety (Nwagwu and Adebayo, 2016). However, after UTME, examinees in public-rural schools have a significantly better attitude and least anxiety than students in the other three categories used in this study after UTME. This is interesting because one may expect contrary results since examinees in rural-public schools have the least access to and use of computers and the poorest performance in UTME. This finding corresponds with the study of (Hosseini, Abidin and Baghdarnia, 2014), where students preferred computer-based tests but performed better in the traditional test. It suggests that exposing students to more computer-based assessments may help to reduce their anxiety and unfavourable attitudes towards CBT.

Furthermore, regression analysis shows CBT attitude and anxiety do not predict test scores. This finding aligns with previous studies of (Brosnan and Lee, 1998; Awad, 2016; Brunfaut, Harding and Batty, 2018; Ebrahimi, Toroujeni and Shahbazi, 2019) where attitude and anxiety have no significant relationship with test scores. However, the results contradict existing studies suggesting that CBT's examinee attitude and anxiety have a positive relationship with performance (Stricker, Wilder and Rock, 2004; Karadeniz, 2011). The finding suggests that while some students may feel more comfortable with computer-based testing, their attitude or anxiety towards it may not significantly impact their performance.

The impact of CBT anxiety and attitude appears to be significantly less powerful than could have previously been predicted. However, attitudes and anxiety are moderately positive. Also, students with low CBT experience had better attitudes and less anxiety about CBT after taking UTME, even though they performed worse in the exam. Therefore, further study is needed to investigate the underlying factors influencing students' attitudes and anxiety about CBT in developing countries. For instance, it would be intriguing to explore why students with less computer experience had a more positive attitude and less test anxiety after taking UTME. Were they simply

more at ease with the technology, or were there more elements at play? The answers to these questions could influence initiatives for enhancing students' experiences with computer-based assessments and technology in general. Consequently, this will improve acceptance of the examination and facilitate digital integration into Nigeria's educational systems.

CHAPTER 6

STUDY 2: INTERVIEWS ON STUDENTS' ATTITUDES AND ANXIETIES TOWARDS THE CBT VERSION OF THE UTME

6.1 Introduction

The quantitative study established that CBT anxiety and attitude appear to be moderately positive among all categories of participants. This chapter explores students' experiences during UTME in more depth and provides insight into the factors contributing to their attitudes and anxiety. Conducting a qualitative study allows us to explore the perspectives of each participant and identify common themes and patterns across their experiences while taking UTME. We also examine if qualitative research might help explain certain intriguing quantitative results. Qualitative data was gathered through interviews. The descriptions of respondents used in this study, and the emergent themes are discussed in this chapter.

6.2 Participants' Description

Table 6.1 describes the participants of the qualitative analysis of this study. Thirteen participants are from Rural-Private schools, 12 from Private-Urban schools, 15 from Rural-Public schools and 10 participants from Urban-Public schools. The students' ages are between 16 and 18 years old.

Table 6. 1: Description of Qualitative Study Participants

Respondents' School-Location Type	Total
Rural-Private	13
Urban-Private	12
Rural-Public	15
Urban-Public	10
Grand Total	50

6.3 Overview of Qualitative Analysis

The qualitative data was analysed to understand students' attitudes, anxieties, and experiences of and towards CBT version of the UTME exam. Thematic analysis (TA) was used to analyse the data and generate themes (see section 4.4.4 for detailed information on themes generation). Three major themes were generated. The first theme, *Anxiety*, discusses any fear about CBT expressed by students during the interview. The second theme, *Positive Attitude*, discusses respondents' positive feelings and beliefs about CBT. Lastly, *Negative Attitude* discusses students' negative feelings about CBT and the challenges faced by students during the exam. Table 6.2 provides an overview of the themes, their sub-themes, and the corresponding number of respondents (N). The evidence gathered from the interviews about students' anxiety about CBT, attitude toward CBT, and difficulties experienced during the UTME is explored in depth below.

Table 6. 2: A summary of themes and sub-theme and the number of respondents with a quote in each sub-theme (N).

Themes	Sub-themes	N (%)
Anxiety to CBT	Fear of a New Exam	26 (52%)
	Anxiety caused by Screen Displayed Time	25 (50%)
	Event of or Anticipated Technical Difficulties	14 (28%)
	The nature of Computer-based Examination	8 (16%)
Positive Attitude to CBT	Speed of Test Completion	21 (42%)
	Ease	18 (36%)
	Opportunity to Use Computer	8 (16%)
	Prevention of Malpractice	5 (10%)
Negative Attitude to CBT	Allocated Exam Time Expend Fast	23 (46%)
	Poor Examination Performance	8 (16%)
	Negative Experience during Examination	9 (18%)

6.4 Anxiety to Computer-based Test

Four topics emerged from the investigation of UTME's examination of computerised test anxiety. 88% of respondents (44/50) expressed anxiety towards CBT or during CBT. Most respondents in this study expressed more than one specific anxiety towards CBT. Even though most respondents in this study expressed more than one specific anxiety towards CBT, 58% of respondents who have taken a CBT test at least once expressed having a better experience in consequent use. For example, respondents R13 and R28:

> *"I did JAMB last year. When I did it before, I was scared, and I wasn't able to get a high score, but this year I wasn't that anxious, I was actually very calm"* – [R13 Urban-Private School]

> *"I was not scared of the exam been on computer since I have operated it in my formal school"* – [R28 Rural-Public School]

The four CBT anxiety themes are explained below, including relevant excerpts from the interview.

6.4.1 Fear of a New Exam

Taking CBT for the first time can be daunting for many students. 52% (26 out of 50) of the UTME examinees acknowledged UTME uneasiness since CBT is an exam they had no experience with or were not acquainted with enough. All categories of students are represented in this theme. Students such as R40 reported being apprehensive about the UTME since it is a new test they had never taken before, in contrast to the paper examinations they had taken their entire lives:

> *"Paper exam wouldn't be scary like computer exam, because paper exam I am familiar with it, we use it in school. While computer exam, it is my first time of using it so the tension will be there"* – [R40 from Rural-Public School].

However, even when students like R21 have practised CBT in preparation for the UTME, they are still anxious about utilising it for the first time during formal examinations.

> *"Yes, I was scared during UTME because ever since I have been writing paper exam, I use to feel normal that, at least this is something I have been doing frequently but when I was about to write JAMB (UTME), I was going for practice, I was like this is my first time, I don't know how this will be"* – [R21 from Urban-Private School].

In addition, respondents such as R48 feel uncomfortable with UTME since the examination is administered in an unfamiliar place or with unfamiliar individuals:

> *"During paper exams I feel comfortable because I will write in my school. But that computer, I will not be with people I know"* – [R48 from Rural-Public School].

6.4.2 Anxiety caused by Screen Displayed Time

The' time displayed on the screen during computer examinations causes distraction and fear for the examinees. 50% (25 out of 50) of participants stated they were scared or distracted by the time displayed on the screen during the CBT examination. Students from all school categories experience anxiety due to time. Respondents such as R9 mentioned that when taking an exam on a computer, they are distracted by the time and fear that they will not have enough time to complete the exam:

> *"On the system, I will be time conscious -the time will be showing. When I am working in the system now, my mind will be on the time, I will be scared may be the time I want to use, I will be scared about the time*." [R9 from Urban-Public School].

In addition, R16 and R30 said that being aware of time prevents them from attentively reading and interpreting/solving problems before picking an answer for fear of not finishing the exam on time:

> *"On the paper now, I think I will have enough time to read the questions, shade myself, if possible I would solve it but on the computer I will be distracted by the*

time -checking that I don't have to spend much time on a question, I have to move to others, I think I prefer paper-based exam". [R16 from Urban-Private School]

"That of computer exam is only the one that is very hard, I will be scared of time, I will be time conscious, I will be in a hurry in that way. So I wont be able to go over the questions, the way I ought to but in the paper exam I will be able to check it. Though the time too will be there but I will not be conscious of time in the examination hall like that of computer." [30 from Rural-Public School]

6.4.3 Event of or Anticipated Technical Difficulties

Examinees feel nervous during computer exams because they fear experiencing technical difficulties or experienced them. 28% of the people who were interviewed (14 out of 50) said they were scared because of technical problems during the exam. Respondents of all groups are represented in this theme. For instance, respondent R20 was afraid of an event of technical problems or self-sabotaging the exam by pressing the wrong keys during the exam. However, respondents such as R22 encountered technical failures which took a while to be addressed, resulting in anxiety and upset during the exam:

"writing exam on computer makes me feel more anxious and nervous because I will be like maybe I can encounter any issue like power failure or mistakenly press something that can cause-that can delay my exam."- [R20 from Urban-Private School].

"The connection actually went off for some time, and when I continued the system went off and it wasted a lot of time. I felt very scared, I wanted to cry."- [R22 from Urban-Private School].

R33 had anxiety during the exam due to witnessing others encountering technical difficulties. However, R2 implied that part of the respondents' apprehension stems from reports from students who have previously taken the exam and encountered a technical issue:

"The computer having fault because the person beside me had that, so seeing the person, about to start I was already scared." [R33 from Rural-Private School]

"I was scared. Because most of the time people will say while you're writing your examinations and the computer off, they may send you out so that"- [R2 from Urban-Public School]

6.4.4 The Nature of Computer-based Examination

Students feared the nature of CBT examination administration and the setting in which the examination took place. 16% (8 out of 50) of respondents spread across all four respondent categories are represented in this theme. Respondents such as R2 said that they are not at ease during CBT because they have trouble navigating the exam, particularly skipping questions and returning to them at a later time:

"In computer-based exam, I feel more like, Let me say in paper-based exam I feel more relaxed because that one, at least you can leave one question and then come back to the other one do. So you do it when you are like, when you understand the question, but during computer-based exam you have to... If you leave the other one, it will be hard for you to go back to the other one for the continuation of your exams" – [R2 from Urban-Public School]

R42 reported being uneasy with the exam seating posture and writing on scrap paper during the examination:

"when I take paper exam, I feel comfortable and I can write with my hands and I can sit well. But you know, computer exam, they gave us something to jot with, but I am not really comfortable with it." – [R42 from Rural-Private School].

At the same time, other respondents, such as R19 and R22, reported feeling fearful for no apparent cause:

"I am just scared when I am using computer-based test than paper-based test. I don't know, but I just feel scared." – [R19 from Urban-Private School]

"because anytime I sit in front of the screen, I feel very nervous and I get stucked up, I won't be able to do anything." – [R22 from Urban-Private School]

6.5 Attitudes to Computer-based Test

The analysis of UTME attitude to CBT revealed two primary themes: positive attitude and negative attitude. First, 31 out of 50 participating UTME examinees (62%) positively perceive CBT. These positive attitudes in further grouped into four sub-themes with detailed discussion. An equal number of respondents (31 out of 50) have negative attitudes to CBT and are divided into four subcategories. Furthermore, an almost equal number of students preferred CBT (48%) and PBT (42%), respectively, while the rest were indecisive. However, 82% (41/50) believe their performance would be the same irrespective of the mode the test is taken. The positive and negative attitudes and corresponding subcategories are discussed below with relevant examples.

6.5.1 Positive Attitude to Computer-based Test

This section discusses UTME examinees' positive attitudes and beliefs about CBT. The positive attitudes have been grouped into four sub-themes and are discussed in detail below with supporting "quotes" from the respondents.

6.5.1.1 Speed of Test Completion

The computer-based exam is popular among students because they can complete it quickly. 42% (21 out of 50) of respondents from all school categories stated that CBT is quicker than writing on paper. For instance, respondent R4 noted in his/her interview response:

> *"paper-based tests- that one is somehow stressful and it use to consume time but computer-based you just have to choose your option. Computer-based is somehow faster, and there's still time for some things I want to do."*- [R4- Urban-Public School].

In addition, respondent R18 stated that experience with CBT aids in better time management:

> *"hmm, it makes us know how to manage our time, because if you do paper-based test and not computer-based test, you won't know how exam feels…"*- [R18 Urban-Private School].

R32 can think more quickly when he can see the clock on the computer screen because there is not as much opportunity for error as there would be in a paper exam:

> *"On the computer, I saw my time was running so I have to know, I think faster what my answer will be. But on paper, I may tick, I may erase, I may tick, I may erase, so on computer makes me think faster to pick my answer"* –[Rural-Private School]

6.5.1.2 Easy Test Navigation

Students prefer CBT because it is simpler to utilise and navigate the examination interface. 36% (18 out of 50) of respondents are represented in this sub-theme. Respondent R8 prefers to take exams using computers whenever possible since it makes her work easier:

> *"If I could choose, I would choose computer because, … It will make my work easier"*- [R8 Urban-Public School].

> *"As for the computer exam, it is more easier than the paper own"*- [R36 Rural-Private School]

Respondent R15 made it clear that the ease of computer exams stems from the lack of the need to shade choices on paper:

> *"I find computer easier. I don't have to be shading the option or the answer."* - [R8 Urban-Private School]

Also, Students have a better attitude toward computer-based exams after taking UTME because it is easier to navigate the examination interface than they had earlier anticipated before taking UTME. In their interviews, Respondents R49 and R26 from rural-public schools stated that they initially thought CBT would be challenging based on what people said about the exam. However, they do not think it is difficult to navigate after taking the examination:

> *"I thought it will be very hard. We use to hear everywhere that JAMB (UTME) is very complicated, especially… we will use computer and if you are not a computer literate, it won't be easy for you. But that day I was surprised when*

they told us that: if you have not experienced computer before that you should raise up your hands. Some people raised up their hands and they teach us how we are going to do it that day."- [R49 Rural-Public School].

"Due to the comments of the people that have done it that say it is hard, I thought it will be hard and after I have done it I don't think it is hard"- [R26 Rural-Public School].

6.5.1.3 Opportunity to Use Computer

Students prefer taking computer-based exams because they can use and engage with computers, something they might not otherwise have the opportunity to do. 16% (8 out of 50) from all student categories are represented in this theme. Respondent R1, in her interview, stated that CBT supports and assists students in learning more about computers, digital technology, and other equipment:

"CBT is encouraging and it's help students to know more about computers and digital or all these machinery"- [R1 Rural-Public School]

Respondent R33 thinks that because computers are becoming more prevalent in the current society, it is important to take CBT to stay current:

"For the kind of generation we are in, we are moving to computer-based, so I will say computer so as not to be left out."- [R33 Rural-Private School]

In addition to keeping up with current trends, participant R40 and R1 think CBT may encourage the use of computers in regions where they are not currently used:

"computer exam is good and it also helps students who don't have knowledge about how to use computer to have knowledge about it. And in some areas where there are problems of technology. It can be improvised or bring down to that area. I think computer examination is the best." [R40 Rural-Public School].

"Is different and like the area of computer is different from the place where we use paper in writing, because when using computer there are some ethics in computer that we we we need to follow in the computer lab. The place needs to be cool, the air conditional, so it's make everywhere cool and even you too your brain will be settled, unlike some environment where you write exam, the place will be hot."- [R1 Urban-Public Schools].

Respondents R13 and R45 think that CBT is fun and fascinating to undertake:

> *"Computer-based test is so fun, I will actually prefer computer-based test right now."*- [R13 Urban-Private School].

> *"CBT was interesting because the mouse is there and the keyboard are there to guide you. Just pick the option and the arrow will tell you"*- [R45 Rural-Public School].

6.5.1.4 Prevention of Malpractice

Students' preference for computer exams may result from a well-organised exam structure and assurance that fraud will not compromise it. Similar to this, R3 believes that the setting in which CBT is conducted discourages malpractice:

> *"My comment is that paper exam is not well organised like computer. In that of computer there won't be malpractice but in that of paper, there is malpractice."*- [R50 Rural-Public School].

Respondent R3 further clarifies this by saying that it is difficult to talk to other examinees during a computer exam:

> *"When writing the exam, you won't cheat on the computer you just focus on your work without talking to anyone"* – [R6 Urban-Public School]

6.5.2 Negative Attitude to Computer-based Test

This section discusses UTME examinees' negative attitudes and beliefs about CBT. The negative attitudes have been grouped into three sub-themes and are discussed in detail below with supporting quotes from the respondents.

6.5.2.1 Allocated Examination Time Expend Fast

When taking a computerised examination, the time allotted can be insufficient to complete the exam thoroughly and on time. When compared to the time available for the paper test, 46% of respondents (23 out of 50) believe the time allowed during CBT is disproportionately short. The following are excerpts from respondents:

"I prefer paper exam,, the time would have been more. I would have more time to solve more questions, look at my work and cross-check. But on the computer exam, I did not really have time to cross-check, that 2 hours in real life, it is like one hour."- [R14 Urban-Private School]

"During the written one, you have to think think before writing but that of computer, you wont have much time to think. So you just pick anyone you want to pick"- [R50 Rural-Public School]

"They are both objectives, but if the written one and the computer one is both objectives, it wont be the same. But that computer one will be fast more than paper"- [R49 Rural-Public School]

6.5.2.2 Poor Examination Performance

Students believe taking computerised test have a detrimental impact on their examination score. This sub-theme includes 16% of replies from all school categories used in this study. Respondents R6 and R39 feel they would score better on a paper test because they could brainstorm more effectively and have more time to complete the exam.

"I will perform better on paper because when you are doing paper you will be able to think and be sure of what you are writing. But on computer, you will be worried about the time, the time will be going before you finish the exam."- [R6 Urban-Public School].

"paper own may give me more mark than the computer own. Because you will think deeply before picking your answer. That of the computer, you just leave everything to God. Because of the time you will just pick and get out." [R39 Rural-Private School].

This is further buttressed by Respondent R42, who feels more uncomfortable during the computer exam and finds it difficult to use the scrap paper supplied during the exam:

"when I take paper exam, I feel comfortable and I can write with my hands and I can sit well. But you know computer exam, they gave us something to jot with but I am not really comfortable with it."

6.5.2.3 Negative Experience during Examination

Students dislike CBT due to their unpleasant experiences with CBT or the possibility of test difficulties. The majority of students did not report experiencing difficulty during the exam; however, 36% of respondents did. For instance, respondent R35 does not favour CBT due to technical issues she encountered during the exam:

> *"computer exam, according to my experience during my JAMB, it was bad. Because during, at the middle of my exam, the generator went off, so we had to wait for 1 hour 30 minutes before we continue our exam."* [R35 Rural-Private School]

Respondent R43 was not provided with writing materials during the examination:

> *"When we went for JAMB exam, they did not allow us to use anything to solve some of the questions we are suppose to solve. If it is paper exam, I will be able to express myself, because I will be able to solve thing, I will be able to answer all the questions with my own thoughts. I will prefer paper exam because I will be able to express myself than using computer."*- [R43 Rural-Private School].

Another respondent, R12's computer malfunctioned more than one time during the exam:

> *"My laptop went off, then they gave me another laptop the mouse was not working, they had to change the mouse for me."*-[R12 Urban-Private School].

Internet connection was also an issue for some students during UTME:

> *"the connection actually went off for some time, and when I continued, the system went off and it wasted a lot of time."*- [R22 Urban-Private School]

Lastly, in some UTME centers, electricity challenge stopped examination abruptly and wasted a significant amount of time; Respondent R34 stated that:

> *"where I took the exam, there was a problem, what problem was that. During the exam, generator went off. It took them 1hr 30mins before we resume."* –[R34 Rural-Private].

During UTME, students experienced discrepancies in the examination contents. For instance, Respondents R15 and R17 had a handful of incomplete questions:

> *"For my English, question 1-5 there was no instructions. Maybe like 10 questions there was no instructions."* -[R15 Urban-Private School].
>
> *"I don't have the comprehension and they gave us five questions to answer, I was not able to answer it and that made me lose mark"* -[R17 Urban-Private School].

This indicates that the test questions given to pupils are flawed and that this may cause them to lose marks through no fault of their own. Exam questions should be subjected to multiple quality assurance phases to confirm their accuracy and appropriateness before being administered to students.

6.6 Discussions

The aim of this qualitative study was to acquire in-depth knowledge of students' attitudes and anxieties towards the CBT version of the UTME exam. This provides additional insights that can help explain the results of the quantitative study. Based on the interview, we identified three major themes from the experiential information provided by the respondents: (1) Anxiety about CBT (88% of respondents), (2) Positive Attitude (62% of respondents), and (3) Negative Attitude (62% of respondents). Each of these themes is discussed below.

6.6.1 Anxiety to CBT

As anticipated, respondents' most significant source of anxiety is fear of taking UTME on the computer. Primarily because the computer is not used as a test medium in most secondary schools in the state, irrespective of school location and school type. This is consistent with findings from (Özalp-Yaman and Çağiltay, 2010; Wibowo *et al.*, 2016) where students who had no prior exposure to CBT initially felt uneasy with it. It is worth knowing that respondents from (Özalp-Yaman and Çağiltay, 2010) studies use computers for 1-7 hours per day. Additionally, Previous studies have also found that students with high familiarity and competence with computers and supporting technologies are more confident while using computer-based technologies (Mumtaz, 2001; Richardson *et al.*, 2002). However, non of the respondent in this study has a personal computer. Therefore, the fear of experiencing CBT for the first time may have

been worsened for the respondents due to their low computer experience and no previous use of CBT for standardised examinations.

Secondly, half of the students are anxious about displayed time on the computer screen during UTME, which prevents them from giving adequate attention to answering questions during CBT. Even though the time on the screen during computer examination is expected to make students aware of the time spent, it seems to be causing heightened time consciousness to a significant number of students. This is consistent with the findings of the (Wibowo *et al.*, 2016) research in which respondents felt anxious about the distracting on-screen timer during computer exams. Also, (Richardson *et al.*, 2002) reported that students were occasionally distracted by attractive visuals during CBT. According to some teachers, the use of technology distracts pupils with concentration problems, and these students score far less on computer assessments (Sullivan *et al.*, 2021).

Thirdly, examinees feel nervous during computer exams because they fear experiencing technical difficulties or experienced them. For instance, the computer used for an exam may lose an internet connection, the computer suddenly freezes/hang, or the electricity disconnected. From the interview, apprehension stems from reports of technical difficulties by previous UTME examinees. Technical difficulties are often a concern during a computer-administered test (Shobayo *et al.*, 2009; Antoun, Nasr and Zgheib, 2015; Brunfaut, Harding and Batty, 2018; Ebimgbo, Igwe and Okafor, 2021). Moreover, computer users are anxious when unexpected things happen (Brosnan and Lee, 1998). Notably, all students who reported having technical difficulties during the examination received technical support. However, the time it takes to receive varies from 10 minutes to 1.5 hours depending on the nature of the difficulty, examination center and supporting technical staff. Technical support during CBT can lessen anxiety during the exam (Adenuga and Mbarika, 2019).

Fourthly, the nature of CBT causes anxiety and discomfort for some respondents. The respondents have difficulty navigating the exam, feel uncomfortable using scrap paper or feel fearfulness of CBT for no known reason. Previous studies report that students find the navigation of questions during CBT difficult and time-consuming,

resulting in major stress when CBT is newly introduced to students (Wibowo *et al.*, 2016; Elsalem *et al.*, 2020). Literature has also shown that students use scrap paper more during PBT than in CBT (Prisacari and Danielson, 2017a). It might be particularly upsetting for students that are used to scrap paper during PBT when they can not do so during computer exams.

6.6.2 Positive Attitude to CBT

Students prefer CBT because test navigation is easy and makes ir easy to attempt the questions on the computer. This supports the findings of (Kim *et al.*, 2018), (Dermo, 2009), (Goldberg and Pedulla, 2002) and (Hosseini, Abidin and Baghdarnia, 2014). (Kim *et al.*, 2018) found that students have longer essays during computer writing examinations and found it more convenient to write CBT, and Goldberg and Pedulla (2002) found that students with better computer skills attempted questions faster during CBT. Respondents in this study have stated that they feel they do not have enough time during CBT; this may have made them attempt questions faster. Although the cognitive load of both paper and computer tests are found to be equivalent, students use scratch paper less during CBT examinations (Prisacari and Danielson, 2017a). Using scrap paper less may also have helped to speed up the exam for certain students. Respondent also stated that a significant amount of time is saved since they do not have to shade correct options on paper. Notably, the “ease” sub-theme explains why students in rural areas have a better attitude to UTME after taking the exam. 60% (9 out of 15) of the respondents from public-rural schools have a better perception of CBT after taking UTME than before taking the exam. They expected the UTME to be hard because they had not taken CBT before. However, after taking the examination, they found it was not as hard as earlier anticipated. This explains the significantly more positive attitude among students from rural-public schools after UTME in the quantitative study.

Students who have not used a computer before or have not done computer exams before saw the mandatory CBT as an opportunity for exposure to computers and CBT. They believe that CBT in a standardized environment makes them in tune with current events and prepares them for future educational endeavours. Studies have found that social expectations have a significant relationship with the perceived usefulness of

computerized tests (Terzis and Anastasios A. Economides, 2011). Also, participants prefer CBT due to its novel test-taking experience and move from the traditional paper testing style to the new computerised one (Hosseini, Abidin and Baghdarnia, 2014).

Students taking UTME find it more organized than the traditional paper examination, which is believed to have contributed to their comfort and concentration during the exam. Also, students enjoyed their computerized test experience and found interaction with computer peripherals such as mouse and keyboards enjoyable. Respondents in (Antoun, Nasr and Zgheib, 2015) also found CBT fun and interesting. Computerised tests also prevented students from malpractice during the exam. Students are not able to peep into other person work nor interact with other students during the exam since students do not have the same exam question. Also, the common practice of exam leakages is completely eliminated during UTME since no one knows the actual questions that will be randomly selected for each exam candidate. Prevention of malpractices is one major reason the UTME was transformed into a computerized test. Difficulty engaging in malpractices in computer exams is one of the most reported advantages of CBT (Antoun, Nasr and Zgheib, 2015; Wibowo *et al.*, 2016; Okoye and Duru, 2020). For example, Okoye & Duru (2020) found that CBT has significantly reduced malpractices in the conduct of UTME.

6.6.3 Negative Attitude to CBT

A portion of students would rather not take a computerised test because the time allocated for a computerised test appears to be shorter than a traditional paper examination. This may be because time is displayed on the screen, which respondents have said causes anxiety and affects their overall perception of CBT. These findings are similar to those (Wibowo *et al.*, 2016; Ebimgbo, Igwe and Okafor, 2021), where students also have a negative attitude toward computers because of time-related disadvantages. Literature also reports that students with low computer expertise may require additional time to become accustomed to using computers and supporting peripherals during CBT, which may be detrimental to their performance (Jamiludin, Darnawati and Uke, 2018). Furthermore, some studies have shown that the ability to

forget the time when using a computer positively correlates with performance in computerised tests (Chan, Bax and Weir, 2018; Yu and Iwashita, 2021).

Certain students believe they would have performed better if the examination were to be on paper. These students believe they will have more time to think during paper exams and be more comfortable during the exam. This is in contrast with students in (Özalp-Yaman and Çağiltay, 2010), where some respondents felt initial discomfort during the exam, but all students believe their performance would have been the same irrespective of the exam mode. However, literature shows that students perform better in paper exams where respondents have little computer experience, like most respondents in this study (Russell and Haney, 1999; Lee and Weerakoon, 2001). Furthermore, the computer-based mathematics test can be considerably more difficult than the paper-based test, and familiarity may be relevant when taking a computer-based mathematics test (Bennett *et al.*, 2008).

If given the option, students who consider their CBT experience unsatisfactory would choose not to use CBT. Negative experiences include technological difficulties, discomfort with the test environment (too cold/hot), and inadequate exam supplies (e.g. scratch paper and scientific calculator). The technical difficulties reported by students vary from delayed exam start times to sudden exam interruptions. Although the interruption did not prevent students from completing the exam, it significantly impacted their view of CBT. Respondents' perceptions of the exam's usefulness and integrity were shown to be adversely impacted by difficulties during CBT (Hillier et al., 2020).

6.7 Conclusion

The qualitative data were used to identify key variables influencing the attitude and anxiety of UTME examinees taking computer-based UTME in Nigeria. Most respondents have at least one anxiety about CBT. The novelty of CBT, the time displayed on the screen, the event of or anticipated technical difficulties and the nature of the exam are the four key factors that caused anxiety for students. 62% of respondents (31 out of 50) have at least one positive attitude to CBT. Exam completion speed, ease, an opportunity to use a computer and malpractice prevention are the students' positive attitudes to computer-administered CBT. Also, 62% of respondents (31 out of 50) have at least one negative attitude toward CBT. Allocated exam time expending faster, poor examination performance and negative experiences during UTME are students' negative attitudes toward UTME. Each theme has a significant presence across all respondent categories. An almost equal number of students preferred CBT (48%) and PBT (42%), respectively, while the rest were indecisive. There is a significant increase in the percentage of students who prefer computer-based tests in comparison to previous studies, where 79% of students prefer PBT during the earlier adoption of CBT for UTME conduct (Joshua, Joshua and Ikiroma, 2014). 82% (41/50) believe their performance would not be different irrespective of the test's mode. 36% of respondents encountered challenges during their examination. 58% reportedly have a better experience with CBT after multiple CBT practices.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

This Chapter will begin by summarising the research's quantitative and qualitative findings. Then, it broadens the discussion to include proposals for improving the conduct of CBT and the students' experience taking the test. It then discusses the project's challenges, the research's key contribution, and limitations before proposing further research areas. Finally, the thesis is summarised and concluded.

7.1 Summary of Findings

Using computers for assessment can provide several benefits for educators and test-takers. However, there is no consensus on the impact of individual differences on CBT performance and experience in the literature. Accordingly, more evidence is needed, especially for students from digitally divided regions. This study was interested in final-year Nigerian secondary school students taking high-stakes computer-based university entrance examinations (UTME). These students have been grouped based on their school type (public or private) and location (rural or urban) locations. The first phase of this study was a quantitative investigation of 402 students from 4 student categories. The quantitative study answers this study's first six research questions (see research questions in section 4.1). It investigated candidates' computer familiarity, paper/CBT anxiety and attitude prior to the UTME and CBT attitude and anxiety after the exam. Also, the relationships between computer familiarity, CBT attitude and, CBT anxiety, and performance during CBT were also established. Afterwards, a qualitative study (50 students interviewed) was conducted to explore the experiences of these students in more depth and gain more insights into the factors that contribute to their attitudes and anxiety. Conducting a qualitative study allows us to explore the perspectives of each participant and identify common themes and patterns across their experiences while taking UTME. We also examine if qualitative research might help explain certain intriguing quantitative results. Thereby providing a more complete understanding of students' attitudes and performance in CBT settings.

7.1.1 Quantitative Findings

Differences in Computer Familiarity/Proficiency and CBT Performance

The study's outcomes highlight noteworthy computer access and usage disparities among students across rural and urban settings and public and private schools. Notably, superior computer access and use are observed in private schools and urban areas. However, the most significant divide emerges between students in public and private schools rather than those in rural and urban locations. Consequently, students in public-rural schools exhibit the least exposure and familiarity with computers.

Furthermore, examinees who have prior experience with computers, access to them at school or home, and previous exposure to CBT statistically outperform their counterparts who lack these advantages. An interesting trend emerges when evaluating scores based on the frequency of previous CBT experiences. The most substantial difference in performance is evident between students who have never undergone CBT before UTME and those with at least six prior experiences. This implies a correlation between students' access to and familiarity with computers and their success in UTME.

This research findings align with existing literature that emphasizes the role of socio-economic factors, school type, and geographical location in shaping computer access and familiarity among students (Ukpebor and Emojorho, 2012; Mpofu and Chikati, 2013; Osuafor and Osisioma, 2014; Olanrewaju *et al.*, 2021). Also, in line with previous research, our findings show a positive relationship between computer familiarity/use and UTME performance (Goldberg and Pedulla, 2002; Zou and Chen, 2016; Shirzad and Shirzad, 2017). This finding contradicts research claiming that computer familiarity does not affect test performance (Al-amri, 2007; Hosseini, Abidin and Baghdarnia, 2014; Chan, Bax and Weir, 2018). These results underscore the need for context-specific strategies to address digital divides, ensuring equitable access and fostering digital literacy for all students, regardless of their socio-economic or geographical backgrounds.

Differences in CBT Anxiety and CBT Performance:

Anxiety Levels Toward PBT and CBT: The findings reveal that students' anxiety generally falls within the lower "unconcerned" anxiety scale when it comes to both PBT and CBT, both before and after the UTME. Notably, students exhibit the least anxiety towards PBT, and there is no significant difference in anxiety levels about CBT before and after UTME. This suggests a consistent level of comfort or lack of apprehension in students' anxiety towards both testing modalities. Similar to the present study, (Kolagari *et al.*, 2018) found that students tend to exhibit consistent anxiety levels across different testing modalities.

Comparison of Anxiety Across Classifications: When examining anxiety levels towards PBT and CBT before UTME based on different student classifications, no significant differences are observed. This implies that regardless of factors such as rural or urban residence, public or private school background and the varying level of computer access and use, students generally share a similar level of anxiety towards PBT and CBT before the UTME. This is supported by studies that have no significant relationship between computer familiarity and computer anxiety (Todman and Lawrenson, 1992; Durndell and Lightbody, 1993).

Unexpected Findings Among Rural Public School Students: An intriguing discovery emerges among rural public school students with the lowest familiarity with computers and CBT. Despite their limited exposure, these students exhibit significantly lower anxiety about CBT after taking the UTME. This paradox may be attributed to an initially unrealistic anxiety level before UTME due to their minimal experience with computers and CBT (Stricker, Wilder and Rock, 2004; Pawasauskas, Matson and Youssef, 2014). This finding underscores the importance of considering the psychological aspects of the digital divide in understanding students' reactions to technological changes in testing formats (Mcdonald, 2002).

Predictive Value of CBT Anxiety on UTME Scores: In assessing the predictive value of CBT anxiety on UTME scores, the results indicate that CBT anxiety is not a significant predictor of students' performance in the UTME. This suggests that while anxiety levels may vary among students, they do not serve as a indicator of their test

scores. This result is supported by the findings of (Awad, 2016). However, this contradicts (Brosnan, 1998), where the number of correct responses in an assessment is directly related to students' anxiety levels. The research sheds light on the nuanced relationship between the digital divide, students' anxiety levels, and their performance in PBT and CBT. These findings emphasize the need for tailored interventions to address psychological aspects of the digital divide and promote equitable testing experiences for all students.

Differences in CBT Attitude and CBT Performance

Attitudes Towards PBT and CBT: The research findings indicate that students generally fall within the lower "positive" attitude scale when it comes to both PBT and CBT, both before and after the UTME. However, it is noteworthy that students tend to express the most positive attitude towards PBT and the least positive attitude towards CBT after the UTME. This suggests a consistent level of optimism or favourable perception towards both testing modalities, albeit with a preference for the traditional PBT format. This is consistent with the literature findings where students also have a preference for a particular test mode over another (Hosseini *et al.*, 2014).

Comparison of Attitudes Across Classifications: An analysis of students' attitudes towards PBT and CBT before UTME based on various classifications, including school type and location, reveals no significant differences. This implies that irrespective of factors such as rural or urban residence, public or private school background and students' computer familiarity/use, students generally share a similar positive attitude towards PBT and CBT before the UTME.

Unexpected Findings Among Rural Students: A surprising discovery emerges when examining attitudes after the UTME, particularly among rural public and private school students. Contrary to expectations, these students exhibit a significantly more positive attitude than their urban counterparts in public and private schools. This unexpected trend may be attributed to an initially unrealistic negative perception of CBT before UTME or the possibility of positive experiences during the examination, influencing a shift in attitude (Deutsch *et al.*, 2012; Pawasauskas, Matson and Youssef, 2014).

Predictive Value of CBT Attitude on UTME Scores: In assessing the predictive value of CBT attitude on UTME scores, the results indicate that CBT attitude is not a significant predictor of students' performance in the UTME. This is consistent with previous research that found no significant relationship between computer attitude and test performance (Boo and Vispoel, 2012; Ebrahimi, Toroujeni and Shahbazi, 2019; Yu and Iwashita, 2021). The results underscore the complex relationship between attitudes towards testing modalities and actual test scores, suggesting that positive or negative attitudes alone may not reliably predict CBT outcomes.

7.1.2 Qualitative Findings

The qualitative study complements the quantitative findings, contributing to a more nuanced and comprehensive understanding of students' attitudes and anxiety towards CBT. The qualitative analysis unveils that a majority of students harbour at least one anxiety related to CBT, with four key factors- the novelty of CBT, the time displayed on the screen, the event of or anticipated technical difficulties and the nature of the exam -emerging as primary sources of concern. The anxiety spread across all student categories used in the study. The causes of anxiety have been reported in other literature, such as the novelty of CBT (Wibowo *et al.*, 2016), on-screen time display (Wibowo *et al.*, 2016), the anticipation of technical difficulties (Awad, 2016; Wibowo *et al.*, 2016), and the exam's nature (Wibowo *et al.*, 2016; Brunfaut, Harding and Olaf, 2018).

Interestingly, an equal number of respondents express preferences for CBT and PBT (PBT), respectively. Moreover, more than half of the students exhibit both positive and negative attitudes towards CBT. Positive attitudes include appreciation for exam completion speed, ease of test navigation, opportunity to use a computer, positive exam experience and malpractice prevention. While all positive and negative attitudes spread across all student categories, the opportunity to use computers is only present among the rural-public school category. Existing literature supports these positive attitudes to CBT-exam completion speed (Brunfaut, Harding and Olaf, 2018), Navigation ease positive exam experiences (Pawasauskas, Matson and Youssef, 2014), and malpractice prevention (Awad, 2016). However, we did not find any study that reports the ability to use a Windows computer as a reason for having a positive attitude toward CBT. This is

likely attributed to the different circumstances of some students in disadvantaged areas using Windows computers for the first time during UTME. Conversely, negative attitudes encompass concerns over allocated exam time expending faster, poor examination performance and negative experiences during UTME. Existing literature supports these findings - allocated exam time expending too quickly (Goldberg and Pedulla, 2002; Wibowo *et al.*, 2016), poor examination performance (Wibowo *et al.*, 2016), and negative experiences (Wibowo *et al.*, 2016) during the UTME.

The qualitative study sheds light on why the quantitative study found no correlation between students' anxiety and attitude towards CBT and their test performance. Despite the quantitative study establishing a positive relationship between computer proficiency and CBT performance, anxiety and attitudes are distributed across all student categories, regardless of proficiency/experience.

Furthermore, the qualitative insights elucidate why students from rural public schools exhibited more favourable attitudes towards CBT after taking the UTME in the quantitative analysis. Post-UTME, 60% of respondents from public-rural schools perceived CBT more positively than before, attributing this shift to the initial expectation of difficulty, which dissipated upon discovering that the exam was not as challenging as anticipated.

The negative attitudes highlighted in the qualitative study underscore the importance of ensuring proper technology functioning and thorough preparation for students before engaging in CBT. Despite initial anxiety, many students maintain positive attitudes towards CBT, viewing it as an opportunity for a novel experience. The results emphasize that factors beyond anxiety and attitude, such as prior computer familiarity and experience, may be more significant determinants of CBT outcomes. This integrated understanding underscores the need for comprehensive preparation and support to enhance student's experiences in the evolving landscape of computer-based assessments.

7.2 Contribution to Knowledge

The research makes a contribution to knowledge by investigating the digital divide among students in Nigeria and its effects on their performance in high-stakes computerized examinations, particularly the Unified Tertiary Matriculation Examination (UTME). The study analysed variations in computer access and use among students in publicly-owned and privately-owned schools in rural and urban locations. By examining the correlations between computer familiarity and UTME performance, the research sheds light on the significance of digital literacy in influencing academic outcomes. Also, this study found that the digital divide does not affect students' attitudes and anxieties towards computer-based testing. This conclusion is crucial because it calls into question the assumption that a digital divide leads to negative attitudes and fear about technology. Furthermore, the qualitative component adds depth to the understanding of students' experiences, uncovering the factors that contribute to their attitudes and anxiety related to computers in the context of high-stakes exams. This discovery advances theoretical knowledge of the elements that contribute to unfavourable attitudes and anxiety towards technology. This nuanced exploration of the digital divide, considering subgroups like rural vs. urban and private vs. public schools, provides a comprehensive understanding of the multifaceted nature of digital inequality and its impact on educational outcomes, thereby enriching the scholarly discourse on the subject. In addition, the study highlights the need for policymakers to prioritize investments in technology and infrastructure to bridge the digital divide gap among students. This information can inform policies and strategies to improve educational outcomes in Nigeria and other situations with similar contexts.

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7.3 Challenges

Some challenges were encountered during the data collection stage of this research. These challenges are highlighted below:

1. The reluctance of students to participate in the studies: some refused to participate because they were not used to filling out consent forms and signing their names during data collection. Signing consent forms during data collection is not a prevalent practice in Nigeria.
2. School reluctance to participate in the studies: it took a significant effort to convince schools (needed to show Strathclyde school ID and United Kingdom Resident Permit), especially private schools, to participate in the study due to the prevalent security challenges in Nigeria.
3. Public schools significantly have fewer UTME candidates than their private school counterparts in both the state capital and rural setting. All students in private schools visited registered for UTME except for the underage ones in rural and urban schools. However, a public secondary school in the rural area of Osun has no students registered for 2021 UTME.

7.4 Recommendations

Based on the findings of this study, we offer the following suggestions to School Administrators, JAMB and Nigerian Governments to improve the conduct of the examination and the experiences of the examinee:

1. Schools (that can afford it) should be encouraged to organise some of their examination on computers. Also, the governments of Nigeria, along with JAMB, should work to provide adequate computer laboratories in each local government where students can practice computer and computer-based examinations at a free or negligible cost. This will allow students of all backgrounds to have access to a computer and practice computer-based tests a significant number of times in a simulated environment before UTME. Practise examinations should generally be structured to replicate the actual testing experience. This will assist students in becoming comfortable with the format and setting of the actual exam.

Additionally, this should reduce students' concerns and anxiety during the examination.

2. Students taking the UTME should be provided with a video instruction that provides step-by-step instructions and procedures for the examination. This should contain instructions on how to log in, navigate questions, and cross-reference answers. This will acquaint and prepare pupils for the day of the examination. Consequently, this may minimise the anxiety of encountering a novel test technique.
3. Common technological issues (power outages, lost Internet connection, computer freezing, and laptop battery failure) should be explained to students, along with the procedure for reporting them and the technical support available. This is intended to reassure pupils that they will not be disadvantaged if any technical concerns arise.
4. The official mock examination should be made available to students remotely, alongside the option of taking it within an approved center. This will allow students who cannot travel to the official mock centers to practice anywhere convenient.
5. The time shown on the screen was a major distraction for the students. Additional functionality may be added to the exam to assist students who are bothered by time to conceal it. In addition, pupils should be guided to carefully attempt questions and not select responses randomly to save time.
6. The performance of students prior CBT and after CBT should be studied for different categories of students over several years before and after computerised test adoption. This will allow UTME stakeholders to identify the effects of change in policy on results and test-takers. Also, the result of the study should be published for general access to the public.
7. Lastly, JAMB should develop a feedback system that allows students taking the exam to give feedback on their experience. This will help identify challenges faced by the students during the exam and mitigate them or give adequate compensation. For example, students who had missing passages should have an avenue to report such discrepancies and students' grades should not be affected.

7.5 Limitations

The main limitation of this project is that it was only carried out in one of Nigeria's 36 states. The findings may not be readily transferable to other states within the country. This is because socioeconomic circumstances, educational financing, and state safety vary throughout Nigerian states. Secondly, only students taking UTME were used in this study; computer access and use results may conceal greater inequalities, especially among rural-public school students where many students did not register for UTME. Thirdly, a significant limitation of this research is the potential lack of depth in the qualitative phase of the study. While the study used a phenomenological qualitative methodology and interviews. Most of the interviews lasted around ten minutes. Because the interviews were brief and the responses were concise, the richness and complexity of the students' digital divide experiences and viewpoints may not have been effectively recorded. However, given the sample's age range (16-18 years old), the researcher did her best to elicit as much important information from the respondents as possible. Lastly, this study only includes students taking the UTME; school instructors and UTME administrators may be able to contribute additional insights that help enhance the conduct of UTME and the experience of students taking the test.

7.6 Future Work

This study provides a solid beginning for additional research into the experiences and opinions of students taking high-stakes computer-based university admission exams in Nigeria. As a result, we call attention to several potential directions for future study in this field. Firstly, this study could be replicated in different states to gain better knowledge and insight into the students who take the exam. This would also allow results comparison and consistency to be monitored nationwide. Secondly, this study can be replicated using advanced data collection and analysis procedures. This can involve the real-time observation and automatic recording of students' actions during the test (such as the time it takes to start and finish the exam, students' apparent orientation, reaction time to questions, and so on). This might give more insights into the experiences and perspectives of students taking UTME in Nigeria. Lastly, we learn in this study that computer inexperience or inadequate familiarity with the

computer may explain differences in performance among UTME students. However, because the digital gap is frequently not an isolated occurrence, other factors not included in this study could influence students' performance. As a result, future research may examine the effects of poverty, school quality, and test preparation quality on students' success in the UTME.

7.7 Conclusion

This study investigates ICT-related individual differences among secondary school students taking large-scale high-stake CBT university entrance examinations in Nigeria and its effects on their performance on the test. This included a review of the literature in order to establish a basic understanding of computer-based examination, digital divide, ICT-related individual differences and related studies. The quantitative study was used to collect data on respondents' perceptions about their computer familiarity/proficiency level, computer-based test anxiety and attitude before and after UTME. Furthermore, a qualitative study was conducted to know the examinees' experience during UTME and its influence on their attitudes and anxiety about CBT. The study's findings revealed significant variations in the access and use of computers among students, especially when comparing students in public and private schools rather than those in rural and urban locations. Also, examinees with high computer experience perform significantly better in UTME. Furthermore, students of all categories have the most positive attitude and the least anxiety about PBT. However, attitude and anxiety towards CBT do not significantly correlate with UTME test scores. Furthermore, qualitative revealed important aspects of students' attitudes and anxiety to CBT. These findings are important to provide insights into the attitude and experience of students taking the UTME in Nigeria and inform better practices and improvements of UTME.

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Appendix A

A.1 Information Sheets: Quantitative Study

A.2 Consent Forms: Quantitative Study

A.3 Pre-Exam Questionnaires

A.4 Post-Exam Information Sheet and Questionnaires

APPENDIX A.1

STUDY 1: A SURVEY-BASED STUDY OF UTME CANDIDATES' COMPUTER-RELATED INDIVIDUAL DIFFERENCES AND THEIR RELATIONSHIP WITH TEST PERFORMANCE

INFORMATION SHEET

Invitation

My name is Zainab Abdulkareem, a PhD student in the Department of Computer and Information Sciences, University of Strathclyde. My supervisors are Dr Diane Pennington and Dr Marilyn Lennon, in the same department and university.

I would like to invite you to participate in this research investigating the significance of students' computer proficiency, computer-based test anxiety and computer-based test attitude prior to and post mandatory computer-based examinations on students' test performance in Nigeria. Participation in this study is voluntary. Before you make any decision on participation, I would like to explain the research to you and what your participation will entail. Please read this information sheet and make sure you understand the content before proceeding or withdrawing from this study. I am pleased to discuss this information sheet further with you, if needed, to help you decide whether to participate in this study or not (please see the end of this information sheet for my contact details).

What is this Research About?

In Nigeria, students who aspire to proceed to tertiary education after secondary school education must take part in the mandatory computer-based Unified Tertiary Matriculation Examination (UTME). However, the socio-economical imbalance in Nigeria has resulted in unequal access to Information Technologies, such as computer and internet access in schools and at home. This study investigates the impact that individuals' computer familiarity, computer-based test attitudes and computer-based anxiety have on mandatory computer-based test performance. In addition, the research investigates how these metrics vary across proficient computer users and amateur computer users in Nigerian public and private secondary schools.

Participants of this study will be final-year secondary school students who are registered to take UTME. The outcome of this research will help further understand the experience of Nigerian students during mandatory computer-based examinations.

What would be taking part entail?

This research is divided into two phases - pre–UTME data collection (up to 2 weeks before you take UTME) and post–UTME data collection (up to two weeks after you have taken the test). If you agree to take part in this research, you will be required to complete pre-UTME and post-UTME questionnaires that will take approximately 15 minutes and 10 minutes to complete, respectively. The first questionnaire will be administered within 1-2 weeks prior to taking UTME. This questionnaire collects data about your level of computer familiarity/proficiency, computer-based test anxiety and computer-based test perception pre-UTME. In the second phase, up to 2 weeks post-UTME you will be provided with another questionnaire collecting information about

computer-based test anxiety and computer-based test perception. The follow-up questionnaire will enable me to capture any shift in your opinion on computer-based test anxiety and perception attitude after taking UTME.

Completing this study is totally up to you. You can withdraw from this research at any point before the commencement of data analysis. If you decide to withdraw, I will stop data collection from you, and any data collected from you will be excluded from the research analysis and subsequently destroyed.

Why have I been chosen?

You have been invited to take part in this study because you registered to take the UTME in 2021. You are a registered student in one of the secondary schools in Osun state, and you are at least 18 years of age.

Do I have to participate in this study?

No. Taking part in this study is entirely voluntary, and you have the right to withdraw from the study at any time during data collection.

Will my identification be kept confidential?

Because this research will collect data in two phases from the same respondents, there will be a need to relate the pre-UTME questionnaire to the post-UTME questionnaire. Hence, each consent form has a unique identifier (randomised 5-character text on the topmost left corner of each consent form). The unique identifier associated with your consent form will be transferred to your pre-UTME and Post-UTME questionnaires. This way your respective pre-UTME and your post-UTME questionnaire can be linked. Also, in the case you discontinue this study, your data can be easily identified and excluded from the study. Filled questionnaires will be transferred to a digital format in Microsoft Excel in order to help with data processing. Similarly, all consent forms will be scanned using an automatic scanning machine. All physical copies of data collected (both questionnaire and consent forms) will be secured in a personal safe until research completion and will be shredded using a shredding machine after completion of the PhD research.

All digital information will be stored in StrathCloud, the university's password-protected cloud storage. Five years after the completion of this research (final submission of the thesis), the data collected will be erased.

What will happen if I wish to withdraw from this study?

You are free to withdraw from this study at any time during the collection of data without stating any reason at all.

What will happen to the results of this study?

The results of this research will be reported in the researcher's thesis and published as research papers in reputable academic journals and conferences. You will not be individually identifiable in any of these publications.

What if there is a problem?

If you have a problem with any aspect of this research, feel free to make a formal complaint with any of my supervisors, Diane Pennington and Marilyn Lennon, using their email: diane.pennington@strath.ac.uk and marilyn.lennon@strath.ac.uk respectively.

Who is organising and funding this research?

This study is part of my PhD research under the guardianship of my supervisors. This research is funded by Petroleum Technology Development Fund (PTDF).

Who is an independent person I can contact in connection with this research?

If you have any questions/complaints/concerns about this research. Please contact the university ethics group for any further clarifications or complaints.

Ethics Team- Computer and Information Sciences
Phone Number-+44 141 548 3189
Email Address- cis-ethics@strath.ac.uk
Department of Computer and Information Sciences
Livingstone Tower, 26 Richmond Street
Glasgow G1 1XH, Scotland, United Kingdom

What happens next?

If you are happy to participate in this research, we will ask you to sign the consent form to attest you are happy to do so.

Full contact details of the researchers?

If there is any need to contact the researchers, you can use any of the following means:

Researcher contact details

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Academic Main Supervisor:

Name: Diane Pennington
Department: Department of Computer and Information Sciences
University: University of Strathclyde
Address: 26 Richmond Street, Glasgow G1 1XH, Scotland, United Kingdom
Email: diane.pennington@strath.ac.uk

Thank you for going through this information sheet.

APPENDIX A.2

STUDY 1: A SURVEY-BASED STUDY OF UTME CANDIDATES' COMPUTER-RELATED INDIVIDUAL DIFFERENCES AND THEIR RELATIONSHIP WITH TEST PERFORMANCE

ID: __OSS0____/

CONSENT FORM FOR STUDENTS PARTICIPATING IN THIS RESEARCH

Title of Project: Impact of Individual Differences on Examinee Test Performance during Mandatory Computer-based Testing

Name of Researcher and contact: Zainab Abdulkareem

zainab.abdulkareem@strath.ac.uk

+234 81 8046 8800

Please initial box

1	I confirm that I have read the information sheet for the study named above. I have had the opportunity to ask questions and found the answers satisfactory.	
2	I understand that data collection from me will be through a questionnaire in two phases, and these questionnaires will be linked to capture change in my opinion prior to and post-UTME.	
2	I understand that my participation is completely voluntary, and I am free to withdraw my participation at any time during the collection of data	
3	I understand that this study will be published without exposing my personal data	
4	I consent to be a participant in this research	

Name of Participant:

Signature of Participant:

Date:

APPENDIX A.3

STUDY 1: A SURVEY-BASED STUDY OF UTME CANDIDATES' COMPUTER-RELATED INDIVIDUAL DIFFERENCES AND THEIR RELATIONSHIP WITH TEST PERFORMANCE

ID: __OSS0____/

Computer Familiarity, Computer-based Test Perception and Anxiety Questionnaire

PRE-UTME QUESTIONNAIRE

SECTION ONE: Computer Familiarity Questionnaire

School Type: [ ] Public [ ] Private

Please select the option that mostly applies to you by clicking on the appropriate box	Never	Rarely	Sometimes	Often	Always
1. Have you used a computer before? [ ] Yes [ ] No *(if your answer is yes, please continue below, if no, please skip to section two)*					
2. How often do you have access to a computer in the following places?					
• School					
• Home					
• Public Library					
• Business Centers					
Please write to other places where you have access to a computer i. …… ii. ……. iii. …….					
3. How often do you use a computer in the following places?					
• School					
• Home					
• Public Library					
• Business Centers					
Please write about other places where you make use of a computer i. …… ii. ……. iii. …….					
4. How often do you use a computer for the following school-related tasks?					

• Word Processing					
• Online Learning					
• Graphics Design					
• Gathering Information					
• Communication					
Please write any other school-related task you use a computer for i. …… ii. ……. iii. …….					
5. How often do you use a computer for non-academic related tasks?					
• Social Networking, Gaming, Entertainment, Word Processing					
• Gaming					
• Entertainment					
• Word Processing					
Please write any other non-academic related task you use a computer for …….					

6. **How many times have you taken a formal assessment using a computer?**

[ ] Never [ ] 1 time [ ] 2-5 times [ ] 6-10 [ ] >10 times *(please tick the appropriate box)*

Did you take part in the 2021 UTME Mock examination: [ ] No [ ] Yes

SECTION TWO: Paper-based/Computer-based Test Attitude Questionnaire

Please note that the Computer-based Test will be referred to as CBT, and the Paper-based Test will be referred to as PBT.

Both PPT AND CBT are MULTICHOICE test question types in relation to this questionnaire.

Please select the option that mostly applies to you by clicking on the appropriate box

1. How do you feel about taking examinations in the following test modes?

PBT: [ ] Very Negative [ ] Negative [ ] Neutral [ ] Positive [ ]Very Positive

CBT: [ ] Very Negative [ ] Negative [ ] Neutral [ ] Positive [ ]Very Positive

2. How easy or difficult is taking an examination in the following test modes?

PBT: [ ] Very Difficult [ ] Difficult [ ] Moderate [ ] Easy [ ] Very Easy

CBT: [ ] Very Difficult [ ] Difficult [ ] Moderate [ ] Easy [ ] Very Easy

3. How pleasant or not is taking an examination in the following test modes?

PBT: [ ] Very Unpleasant [ ] Unpleasant [ ] Neutral [ ] Pleasant [ ]Very Pleasant

CBT: [ ] Very Unpleasant [ ] Unpleasant [ ] Neutral [ ] Pleasant [ ]Very Pleasant

4. How confident are you that the assessment results in the following test mode are your true assessment score?

PBT: [ ] Very doubtful [ ] Doubtful [ ] Neutral [ ] Confident [ ] Very confident

CBT: [ ] Very doubtful [ ] Doubtful [ ] Neutral [ ] Confident [ ] Very confident

5. What relationship, if any, do you feel the following test modes have on your test performance?

PBT: [ ] Very Negative [ ] Negative [ ] Neutral [ ] Positive [ ]Very Positive

CBT: [ ] Very Negative [ ] Negative [ ] Neutral [ ] Positive [ ]Very Positive
6. If I could choose, I would rather take my multi-choice assessment using this assessment mode: [ ] PBT [ ] Neutral [ ] CBT Please give reason(s).

SECTION THREE: CBT/PBT Anxiety Questionnaire

Please mark the option that mostly applies to you by clicking on the appropriate box

1. How do you feel physically taking a test in the following test modes? PBT: [ ] Very Uncomfortable [ ] Uncomfortable [ ] Neutral [ ]Comfortable [ ]Very Comfortable CBT: [ ] Very Uncomfortable [ ] Uncomfortable [ ] Neutral [ ] Comfortable [ ]Very Comfortable
2. What is your level of focus or distraction during the following test mode? PBT: [ ]Very Distracted [ ] Distracted [ ] Neutral [ ] Focused [ ] Very Focused CBT: [ ]Very Distracted [ ] Distracted [ ] Neutral [ ] Focused [ ] Very Focused
3. How fearful or confident were you during the following test modes? PBT: [ ]Very Fearful [ ] Fearful [ ] Neutral [ ] Confident [ ] Very Confident CBT: [ ]Very Fearful [ ] Fearful [ ] Neutral [ ] Confident [ ] Very Confident
4. How nervous or relaxed do you feel during the following test modes?
PBT: [ ]Very Nervous [ ] Nervous [ ] Neutral [ ] Relaxed [ ] Very Relaxed CBT: [ ]Very Nervous [ ] Nervous [ ] Neutral [ ] Relaxed [ ] Very Relaxed

APPENDIX A.4

STUDY 1: A SURVEY-BASED STUDY OF UTME CANDIDATES' COMPUTER-RELATED INDIVIDUAL DIFFERENCES AND THEIR RELATIONSHIP WITH TEST PERFORMANCE

ID: __OSS0____/

Post-UTME Computer-based Test Perception and Anxiety Questionnaire

INFORMATION SHEET AND CONSENT FORM

Dear Respondent,

Thank you very much for taking part in the first phase of data collection. We hope you will choose to complete this study. This second phase of data collection is strictly for those who took part in the first phase of data collection in June 2021.

In the United Kingdom, it is mandatory that when data is collected from humans, participants must sign a consent form to signify voluntary participation in the study. This is even especially important in this study to link the first phase of data collection in this study to the second phase.

Please write your name, signature, and date of data collection below. In case that you are not comfortable writing your full name. Please write your initials. All data collected is strictly for research purposes. We guarantee the safe keeping of your information, and the data collected will not be linked to you or your school. Thank you once again.

Yours faithfully,

Zainab Abdulkareem
08180468800
zainab.abdulkareem@strath.ac.uk
PhD researcher,
University of Strathclyde, United Kingdom.

I, (Name)_____
consent to take part in the second phase of this study.
Signature:
Date:

STUDY 1: A SURVEY-BASED STUDY OF UTME CANDIDATES' COMPUTER-RELATED INDIVIDUAL DIFFERENCES AND THEIR RELATIONSHIP WITH TEST PERFORMANCE

POST-UTME QUESTIONNAIRE **ID: __OSS0____/**

Computer-based Test Perception and Computer-based Test Anxiety Questionnaire

UTME (JAMB) Cumulative Score: _____ (Please provide your **true score**, this will not be linked back to you or your school. It is strictly for research purposes). ***Please note that the Computer-based Test will be referred to as CBT***

SECTION ONE: Computer-based Test Attitude Questionnaire

Please select the option that mostly applies to you by clicking on the appropriate box
1. How do you feel about taking examinations in the following test mode? CBT: [ ] Very Negative [ ] Negative [ ] Neutral [ ] Positive [ ]Very Positive
2. How easy or difficult is taking an examination in the following test mode? CBT: [ ] Very Difficult [ ] Difficult [ ] Moderate [ ] Easy [ ] Very Easy
3. How pleasant or not is taking an examination in the following test mode? CBT: [ ] Very Unpleasant [ ] Unpleasant [ ] Neutral [ ] Pleasant [ ]Very Pleasant
4. How confident are you that the results of the assessment in the following test mode are your true assessment score? CBT: [ ] Very doubtful [ ] Doubtful [ ] Neutral [ ] Confident [ ] Very confident
5. What relationship do you feel the following test modes have with your test performance? CBT: [ ] Very Negative [ ] Negative [ ] Neutral [ ] Positive [ ]Very Positive
6. If I could choose, I would rather take my multi-choice assessment using this assessment mode: [ ] PBT [ ] Neutral [ ] CBT Please give reason(s).

SECTION TWO: Computer Anxiety Questionnaire *(Please mark the option that applies to you best)*

1. How do you feel physically taking a test in the following test modes? CBT: [ ] Very Uncomfortable [ ] Comfortable [ ] Neutral [ ] Comfortable [ ] Very Comfortable
2. What is your level of focus or distraction during the following test mode? CBT: [ ]Very Distracted [ ] Distracted [ ] Neutral [ ] Focused [ ] Very Focused
3. How fearful or confident were you during the following test modes? CBT: [ ]Very Fearful [ ] Fearful [ ] Neutral [ ] Confident [ ] Very Confident
4. Do you have the same experience with computer-based tests as paper-based tests? [ ] Yes [ ] No
i. How would you rate your experience using a computer for academic assessment? [ ]Very Negative [ ] Negative [ ]Undecided [ ] Positive [ ]Very Positive

Appendix B

B.1 Information Sheets: Qualitative Study

B.2 Consent Forms: Qualitative Study

B.3 Interview Script

B.4 Research Data Management Plan

B.5 Sample of Interview Transcript

APPENDIX B.1

STUDY 2: INTERVIEWS ON STUDENTS' ATTITUDES AND ANXIETIES TOWARDS THE CBT VERSION OF THE UTME

INFORMATION SHEET

Invitation

My name is Zainab Abdulkareem, a PhD student in the Department of Computer and Information Sciences, University of Strathclyde. My supervisors are Dr Diane Pennington and Dr Marilyn Lennon, in the same department and university.

I would like to invite you to participate in this research investigating the significance of students' computer proficiency, computer-based test anxiety and computer-based test attitude prior to and post-mandatory computer-based examination on students' test performance in Nigerian Secondary Schools. Participation in this study is voluntary. Before you make any decision on participation, I would like to explain the research to you and what your participation will entail. Please read this information sheet and make sure you understand the content before proceeding or withdrawing from this study. I am pleased to discuss this information sheet further with you if needed to help you decide whether to participate in this study or not (please see the end of this information sheet for my contact details).

What is this Research About?

In Nigeria, students aspiring to proceed to tertiary education after secondary school must participate in the mandatory computer-based Unified Tertiary Matriculation Examination (UTME). However, the socio-economical imbalance in Nigeria has resulted in unequal access to Information Technologies, such as computer and internet access in schools and at home. This study investigates the impact of individuals' computer familiarity, computer-based test attitudes and computer-based anxiety on mandatory computer-based test performance. In addition, the research investigates how these metrics vary across proficient and amateur computer users in Nigerian public and private secondary schools.

Participants of this study will be final-year secondary school students registered to take UTME. The outcome of this research will help further understand the experience of Nigerian students during mandatory computer-based examinations.

What would be taking part entail?

Suppose you agree to take part in this research. In that case, you will be required to complete an interview process that will take approximately 30 minutes. The questions are related to your level of computer familiarity/proficiency, computer-based test anxiety and perception. These questions will enable us to understand the reason behind your computer-based test anxiety and attitude.

Completing this study is totally up to you. You can withdraw from this research before the commencement of data analysis. If you decide to withdraw, I will stop data collection from you. Any data collected from you will be excluded from the research analysis and destroyed.

Why have I been chosen?

You have been invited to participate in this study because you previously took UTME. You are a registered student in one of the secondary schools in Osun state, and you are at least 18 years of age.

Do I have to participate in this study?

No. Taking part in this study is entirely voluntary, and you have the right to withdraw from the study at any time during data collection.

Will my identification be kept confidential?

Each consent form will have a unique identifier which will be related to data collected from the consenter. Only the researcher knows the unique identifier assigned to each participant. It is solely used to connect the consenter to their respective interview. Interviews with each participant will be recorded using voice recording devices. All consent forms will be scanned using an automatic scanning machine and uploaded to OneDrive, the university's password-protected cloud storage. Similarly, recorded interviews will also be uploaded to OneDrive and deleted from the audio recorder. The primary researcher will transcribe all recorded interviews into text format to aid with data analysis on Nvivo. After completion of this research (final submission of the thesis), the data collected will be erased after five years.

What will happen if I wish to withdraw from this study?

You are free to withdraw from this study at any time during the collection of data without stating any reason at all.

What will happen to the results of this study?

The research results will be reported in the researcher's thesis and published as research papers in reputable academic journals and conferences. You will not be individually identifiable in any of these publications.

What if there is a problem?

If you have a problem with any aspect of this research, feel free to make a formal complaint with any of my supervisors, Diane Pennington and Marilyn Lennon, using their email: diane.pennington@strath.ac.uk and marilyn.lennon@strath.ac.uk respectively.

Who is organising and funding this research?

This study is part of my PhD research under the guardianship of my supervisors. This research is funded by Petroleum Technology Development Fund (PTDF).

Who is an independent person I can contact in connection with this research?

Suppose you have any questions/complaints/concerns about this research. Please contact the university ethics group for any further clarifications or complaints.

Ethics Team- Computer and Information Sciences

Phone Number-+44 141 548 3189

Email Address- cis-ethics@strath.ac.uk

Department of Computer and Information Sciences

Livingstone Tower, 26 Richmond Street

Glasgow G1 1XH, Scotland, United Kingdom

What happens next?

If you are happy to participate in this research, we will ask you to sign the consent form to attest you are happy to do so.

Full contact details of the researchers?

If there is any need to contact the researchers, you can use any of the following means:

Researcher contact details

Name: Zainab Abdulkareem

Department: Department of Computer and Information Sciences

University: University of Strathclyde
Address: 16 Richmond Street, Glasgow G1 1XQ, Scotland, United Kingdom
Email: zainab.abdulkareem@strath.ac.uk
Phone number: +234 81 8046 8800

Academic Main Supervisor:

Name: Diane Pennington
Department: Department of Computer and Information Sciences
University: University of Strathclyde
Address: 26 Richmond Street, Glasgow G1 1XH, Scotland, United Kingdom
Email: diane.pennington@strath.ac.uk

Thank you for going through this information sheet.

APPENDIX B.2

STUDY 2: INTERVIEWS ON STUDENTS' ATTITUDES AND ANXIETIES TOWARDS THE CBT VERSION OF THE UTME

CONSENT FORM FOR STUDENTS PARTICIPATING IN THE STYUDY

Title of Project: Impact of Individual Differences on Examinee Test Performance during Mandatory Computer-based Testing

Name of Researcher and contact: Zainab Abdulkareem

zainab.abdulkareem@strath.ac.uk

+234 81 8046 8800

Please initial box

1	I confirm that I have read the information sheet for the above-named study. I have had the opportunity to ask questions, and I have found the answers satisfactory.	
2	I UNDERSTAND THAT DATA COLLECTION FROM ME WILL BE THROUGH INTERVIEWS WHICH WILL BE RECORDED	
2	I understand that my participation is completely voluntary, and I am free to withdraw my participation at any time during the collection of data	
3	I understand that this study will be published without exposing my personal data	
4	I consent to be a participant in this research	

Name of Participant:

Signature of Participant:

Date:

APPENDIX B.3

STUDY 2: INTERVIEWS ON STUDENTS' ATTITUDES AND ANXIETIES TOWARDS THE CBT VERSION OF THE UTME

Interview Questions

1. Where do you use a computer, and what do you do with it?
2. How would you rate your experience level with using computers on a day-to-day basis? ***Novice*** *(I can barely do anything on a computer by myself),* ***Intermediate*** *(I sometimes need help to complete tasks), and* ***Professional*** *(I rarely need help to complete tasks).*
3. Have you done UTME on paper before?
    a. Before taking the Unified Tertiary Matriculation Examination (UTME), have you done Computer Based Test (CBT) before?
    b. Where and how many times?
    c. What is your opinion about the paper version and computer version of UTME?
4. What was your experience during UTME, and does this vary to paper tests?
    a. What do you think are the factors that result in your experience?
5. What do you think about taking the UTME test using a computer before and after the exam?
6. What do you think can be done to improve your examination experience?
7. Do you think your performance would be the same if the exam were to be on paper, and why?
8. How did you feel during the paper test and computer test?
9. Have you taken a computer-based examination multiple times? Did you feel better or worse after multiple exams?
10. What do you think made to feel how you feel during a computer-based examination?
11. What problem, if any, did you encounter during the exam and why?
12. If you could choose which test mode would you write your UTME, which would you choose?
13. Do you have any other comments about doing exams through either paper or computer versions?

APPENDIX B4:

DATA MANAGEMENT PLAN

Project Name:	Digital Divide and its Impact on the Performance of Students Taking high-stake Computer-based University Entrance Examination in Nigeria.	**Funder:**	PTDF, Nigeria
Project Description:	This study investigates ICT-related individual differences among secondary school students taking large-scale high-stake CBT university entrance examinations in Nigeria and its effects on their performance on the test.		
Student:	Zainab O. Abdulkareem	**Supervisors:**	Dr Diane Pennington and Dr Marylin Lennon
Institution:	University of Strathclyde	**Dept / School:**	Computer and Information Sciences
Date of First Version:	22/10/2020 6		
Date of Updates:	05/04/2022 04/04/2021 25/03/2021 12/03/2021 02/01/2021		

Data Collection
Data to be collected and created?

Data type	Original format	Preservation format*	Estimated volume	IPR Owner	Active storage location	Completed storage location
Survey Data	Paper	.pdf	<100MB	UoS	OneDrive	Pure
Consent Forms	Paper	.pdf	<100MB	UoS	OneDrive	Pure
Interview Data	Audio	.mp3	<100MB	UoS	OneDrive	Pure
Consent Data	Paper	.csv	<100MB	UoS	OneDrive	Pure

How will the data be collected or created?

- **Quantitative Study**

  Data will be collected through the face-to-face distribution of questionnaires to 2021 Unified Tertiary Matriculation examinees before and after UTME, respectively. Participants will be asked about their computer familiarity level, their computer-based test attitude, and computer-based test anxiety prior to the exam. In the second phase of data collection, participants' UTME cumulative scores, computer-based test attitude and computer-based test anxiety will be collected after the exam. Paper questionnaires will be transferred to digital format and saved in the university's virtual storage system, StrathCloud. The questionnaire will be stored in files using school pseudo identifier, school type and date. Versions of data will be labelled according to version number and date. Overall, data management processes adopted in this research will be monitored by my supervisors to ensure quality and compliance with ethics.

  Qualitative Study

  Respondents will be interviewed face-to-face about their perception of computer-based tests and their anxiety towards them. All interviews will be recorded in preparation for data analysis. This will help us understand the reason behind respondents' attitudes and anxiety towards computer-based tests.

1. Documentation and Metadata

What documentation and metadata will accompany the data?

A piece of detailed information needed to read and interpret data used in this study will be provided in the thesis and supporting documents. This includes information about the research, the kinds and definitions of data collected, and procedures taken to collect data and analyse data.

2. Ethics and Legal Compliance

How will you manage any ethical issues?

This research provides an information sheet to the participants that contain detailed information about the research, the data needed from research participants and how it will be used, what their participation in the research will entail, and their right to withdraw at any point during the collection of data. Also, research participants are encouraged to ask questions about anything unclear to them about the research until they are satisfied to proceed with the research or withdraw from it. Before participating in the research, participants must sign a consent form after going through the research information sheet. Additionally, the research supervisors' names and contact details and the university ethics

committee are supplied to the participants if they would like to make a formal complaint about the research.

Each consent form will have a unique identifier which will be related to data collected from the consenter. Only the researcher knows the unique identifier assigned to each participant, and it is solely used to connect the consenter to their respective interview. Interviews with each participant will be recorded using voice recording devices. All consent forms will be scanned using an automatic scanning machine and uploaded to OneDrive, the university's password-protected cloud storage.

Filled questionnaires will be transferred to a digital format in Microsoft Excel in order to help with data processing. Similarly, all consent forms will be scanned using an automatic scanning machine. All physical copies of data collected (both questionnaire and consent forms) will be secured in a personal safe until research completion and will be shredded using a shredding machine after completion of the PhD research. Correlative and associative relationships will be evaluated using SPPS and any other statistical interpretative tools. All digital information will be stored in the strathCloud, the university password-protected storage. After completion of this research (final submission of the thesis), the data collected will be erased after five years.

All recorded interviews will also be uploaded to OneDrive and deleted from the audio recorder. All recorded interviews will be transcribed into text format to aid with data analysis on Nvivo. After completion of this research (final submission of the thesis), the data collected will be erased after five years.

How will you manage copyright and IPR issues?

Data from this research is open access, meaning it is available for reuse, given that it is properly cited.

3. Storage and Backup

How will the data be stored during research, and how will you manage access and security?

All hard-copy questionnaires will be transferred to digital format and stored in StrathCloud while this research is active. After the hard copy questionnaire is transformed into digital format, the hard copy will be shredded and destroyed. The hard copy of the consent forms and questionnaire will be locked away at the research site as long as the research is active. After completion of the research, all hard copies of the data collected are shredded. Digital data is transferred from strathCloud to PURE, the university-secured data repository.

All recorded interviews will be transcribed and stored in OneDrive while this research is active. After transcription and transfer of the audio recording to the cloud storage, the audio recording will be deleted from the recording device. After completion of research, digital data is transferred from OneDrive to PURE, the university-secured data repository.

4. Data Curation and Open Access to Data

How will data preservation and open access to data be managed?

After completion of this research, all data that contributed to the research findings will be uploaded to PURE, a University of Strathclyde open-access portal that provides information about projects, research staff and impact. This ensures the proper preservation of data and allows its availability for referencing and research purposes.

Are any restrictions on data sharing required?

The data used in this research is anonymised; hence no data is restricted.

5. Responsibilities and Resources

Who is responsible for data management?

The researcher will be responsible for implementing all the data management activities, and the research supervisors will be responsible for ensuring all processes follow the appropriate guidelines.

What resources will you require to deliver your plan?

All in one Printer auto-document feeder - print, copy and scan
Audio Recorder

APPENDIX B.5

INTERVIEW TRANSCRIPTS

INTERVIEW TRANSCRIPT 002

Audio ref: Respondent 002

Respondent Type: Public-Urban School.

Researcher: Where do you use a computer, and what do you do with it?

Responder 002: I use computer at home, in school and also in work places?

Researcher: How would you rate your experience level using a computer on a day-to-day basis? Would you say you are a novice and always need help when you are using a computer, or you are an intermediate who sometimes needs help or a professional who rarely needs help?

Respondent 002: I am an intermediate because I don't know most of everything on a computer

Researcher: Have you done UTME on paper before?

Respondent 002: No

Researcher: Before taking you to me, have you done computer-based exam before?

Respondent 002: Yes

Researcher: where and how many times?

Respondent 002: In School, like thrice

Researcher: What is your opinion about the paper version and computer version of UTME?

Respondent 002: The paper version of UTME, I can say it is slow because you have to write on book and then for the computer-based you just have to pick your option, the answer, that you think is correct and the paper version If you are not careful with your time, the time will be up.

Researcher: What was your experience during UTME , and do you think it's different from when you take paper exams?

Respondent 002: Yes, Because during UTME examinations you don't have to check through the other person's work or for you to like say you want to look onto what the other person is doing. But you will just concentrate on your own computer. That is the thing that is just different there.

Researcher: OK, does that means you have better concentration when you write on a computer?

Respondent 002: Yes

Researcher: What was your expectation before taking UTME, and was it the same as the reality of your experience when you did UTME?

Respondent 002: I was expecting something that would be at least much more different from that of the school exam, like the paper examinations, Like writing.

Researcher: do you mean you didn't think it was different?

Respondent 002: Yes.

Researcher: What do you think would improve the experience? Is there any way that the experience can be better?

Respondent 002: Yes, if they can improve the way the computer is.

Researcher: What happened to your computer?

Respondent 002: While I was writing my examinations, my computer died like the thing went off. So I had to wait for about up to 10 minutes before they would take me to another computer so I can continue my examinations.

Researcher: How did you feel when that happened?

Respondent 002: I was scared. Because most of the time people will say while you're writing your examinations and the computer off, they may send you out so that.. but on getting there, It was not like that.

Researcher: OK, you were able to get the assistant, right?

Respondent 002: Yes, ma'am.

Researcher: Do you think your performance will be the same if it were to be on paper?

Respondent 002: I would say yes and no.

Researcher: why?

Respondent 002: Because The reason why I said yes was If I will be writing it on paper, the person that will be marking my paper would be like, let me assist that in this place. Assuming she might have gotten something there, but let me just assist her but on computer, it is the computer that is marking. So it depends on what you right, that's what you're going to get.

Researcher: But you know, it's a Multichoice exam person. They cannot really help you; there are no workings marking. Given that, do you think your performances would have been the same? What do you think would have affected your performance?

Respondent 002: Time.

Researcher: So which one do you have better time management?

Researcher: on the computer

Researcher: How do you feel during computer-based exams and paper-based exams?

Respondent 002: In computer-based exam, I feel more like, Let me say, OK, in paper-based exam I feel more relaxed because that one, at least you can leave one question and then come back to the other one do. So you do it when you are like, when you understand the question but during computer-based exam you have to... If you leave the other one, it will be hard for you to go back to the other one for the continuation of your exams.

Researcher: OK, so in paper-based exam you felt more relaxed?

Researcher: If you have taken a computer-based exam multiple times, like you said, did you feel better or worse after multiple exams? Like how would you compare your first-time experience with your fourth-time experience?

Respondent 002: It was, It was OK. It got better.

Researcher: What do you think made you feel how you felt during the exam? You said you felt not as relaxed as you would have felt when you were doing the paper exam. What do you think is the reason for that?

Respondent 002: Because before we even began the examination self, the generator was already like already having some kind of issues or kind of problems, so everybody was already scared that how would this exam be since this is what they used to welcome us. So people were already scared of the way their exams will be.

Researcher: Was there any other problem you encountered during the exam?

Respondent 002: No, just that the computer shuts down and the generator, we did not start in good time.

Researcher: But were you able to use your full-time?

Respondent 002: Yes

Researcher: If you could choose to write the exam in any mode, it's going to be the same exam and multichoice exam. Which one would you choose, a computer-based exam or a paper-based exam?

Respondent 002: Computer-based

Researcher: Why?

Respondent 002: Because I will just choose my options.

Researcher: It's convenient?

Respondent: Yes

Researcher: Do you have any other comments about exams, either paper-based or computer-based exam?

Respondent 002: No

Researcher: Thank you for your participation.

INTERVIEW TRANSCRIPT 015

Audio ref: Respondent 015

Respondent Type: Private-Urban School.

Researcher: Where do you use a computer, and what do you do with it?

Respondent 015: I use computer at home and I watch movies and play games, I listen to music too.

Researcher: Do you use computers in school

Respondent 015: Yes

Researcher: What do you do with it?

Respondent: For our data processing practical, we use it but not every time.

Researcher: Any other place you use a computer?

Respondent: Just at home

Researcher: How would you rate your experience level using a computer on a day-to-day basis? Would you say you are a novice and always need help when you are using a computer, or you are an intermediate who sometimes needs help or a professional who rarely needs help?

Respondent 015: Intermediate

Researcher: Have you done UTME on paper before?

Respondent 015: No.

Researcher: Before taking UTME, have you done other computer-based exams?

Respondent 015: Yes

Researcher: Where and how many times?

Respondent 015: I school and like-maybe 10

Researcher: What was your experience during UTME, and does it vary to paper-based tests?

Respondent 015: My experience.. I was scared.

Researcher: Is it different to a paper-based test?

Respondent 015: Yes

Researcher: Why were you scared?

Respondent 015: because all my computer based test, I have not have upto 200 before, I am always having 100 and something. That is it.

Researcher: Do you think the mode of exam affects your performance?

Respondent 015: Like how?

Researcher: Because it is a computer-based exam, do you think it affects your performance?

Respondent 015: No

Researcher: What do you think about the UTME exam before the exam and after the exam?

Respondent 015: before I got.. more prepared and after the exam the it was ok.

Researcher: before the exam, you were? I don't get it.

Respondent 015: before the exam I was scared, because I don't want to write it next year.

Researcher: but after the exam, you felt, it wasn't as bad as I thought.

Respondent 015: Yes.

Researcher: What do you think can be done to improve your experience during computer-based exams?

Respondent: Reading

Researcher: studying better?

Respondent: Yes

Researcher: What else?

Respondent: and practicing more.

Researcher: with?

Respondent: with computer.

Researcher: do you think your performance would have been the same if the exam would have been on paper, and why?

Respondent: No

Researcher: Why?

Respondent 015: because I find computer easier

Researcher: What made it easier

Respondent 015: I don't have to be shading the option or the answer.

Researcher: any other thing that made your experience different

Respondent 015:No

Researcher: How did you feel during the exam? Were you excited, were you scared, were you happy?

Respondent 015: I was scared

Researcher: Why were you scared?

Respondent 015: like I said before I don't want to write JAMB next year, and I was afraid that computer will shut-down, or computer will off, or the time will finish before I am done.

Researcher: You said you have taken the exam multiple times; if you compare the first time you took it and the latest time you took it. Was your experience the same all through, or better or worse after multiple times?

Respondent 015: Better

Researcher: What do you think made you feel better?

Respondent 015: because I passed.

Researcher: if you had not seen your result, would you still have felt better just based on your experience during the exam? Would you have felt better?

Respondent 015: Yes

Researcher: What problem, if any, did you encounter during the exam?

Respondent 015: For our English, question 1-5 there was no instructions. Maybe like 10 questions there was no instructions.

Researcher: Any other problem?

Respondent: No

Researcher: If you could choose which test mode you would write your UTME in, which one would you choose?

Respondent 015: Still computer.

Researcher: Why the computer?

Respondent: I don’t have to shade.

Researcher: do you have any other comments about the exam, maybe paper-based or computer-based?

Respondent: No

Researcher: thank you so much for your participation.

INTERVIEW TRANSCRIPT 032

Audio ref: Respondent 032

Respondent Type: Private-Rural School.

Researcher: Where do you use a computer, and what do you do with it?

Respondent 032: I use computer mainly in my mum's shop, so I only use it for maybe typing, do research on it and do some 3D painting. Something like that.

Researcher: How would you rate your experience level with using a computer on a day-to-day basis? Would you say you are a novice, you can barely do anything on the computer on your own? Or you are an intermediate, you sometimes need help to complete computer tasks? Or a professional: you rarely need help completing tasks?

Respondent 032: I am not a professional but actually I have a laptop like so I use- whenever I am bored I use the laptop and build on my skills like all these Corel Draw, I do like paint all these. I am not a professional, I am still learning.

Researcher: will you say you are a novice or an intermediate?

Respondent 032: I am not a novice, I am an intermediate.

Researcher: Have you done UTME on paper before?

Respondent 032: No.

Researcher: before taking UTME, have you done a computer-based test before?

Respondent 032: Yes, only on phone

Researcher: no, on a computer?

Respondent 032: no

Researcher: How do you feel about paper exams and computer exams?

Respondent 032: About paper, you feel like- you are on face-to-face with paper so you express yourself more but when you are on computer, your time is running and you have to pick your answers faster.

Researcher: What effect does that have on you?

Respondent 032: for the computer, it did not affect me that much, though I was not use to it. I had so many seniors that told me about it- how to get rid of my mistakes.

Researcher: what were your thoughts about UTME before the exam? Now that you have taken UTME, what are your thoughts?

Respondent 032: my thoughts for UTME were like, how many questions will I answer, how will my time run, how does the place feel like. And after the UTME, after I was done with it, I felt relieved, like I have passed already.

Researcher: What would you say your experience was like, and what can be done to improve your experience?

Respondent 032: I could have been use to computer, I am use to computer but UTME on computer I was not use to it.

Researcher: do you think if you had taken your exam on a computer your results would have been the same?

Respondent 032: No

Researcher: Why?

Respondent 032: because on the computer, I saw my time was running so I have to know, I think faster what my answer will be. But on paper, I may tick, I may erase, I may tick, I may erase, so on computer makes me think faster to pick my answer.

Researcher: what would you say is your general feeling when you take paper exam and when you take a computer exam? How do you feel within yourself?

Respondent 032: When I take paper exam, I feel like, I see my paper face-to-face but when I am on computer I know that is not my computer and so many people are there so I have to cope and do what I have to do and go.

Respondent 032: how do you feel? Comfortable, agitated, scared?

Respondent: I feel comfortable and scared at the same time.

Researcher: on paper or computer?

Respondent 032: that was on computer.

Researcher: what of on paper?

Respondent 032: I don’t feel scared, but I feel comfortable.

Researcher: What do you think makes you feel scared and comfortable at the same time when you take a computer exam?

Respondent 032: when I took to computer exam, I was not use to computer exam before, I was first scared and I also saw many people over there also writing same exam. But when I am on paper, I feel like I am in my own school writing the same paper and I have written paper exam for than 5 or 10 times.

Researcher: did you experience any problems during your exam?

Respondent 032: No, I didn’t.

Researcher: If you could choose the test mode to write your test in, whether paper or computer? Which one would you choose?

Respondent 032: I will rather go for computer because I know computer will make me think faster and to know my answer.

Researcher: do you have any other comments about exams in general, whether paper or computer exams?

Respondent 032: No

Researcher: thank you very much for your participation.

INTERVIEW TRANSCRIPT 040

Audio ref: Respondent 040

Respondent Type: Private-Rural School.

Researcher: Where do you use a computer, and what do you do with it?

Respondent 040: I used it for my JAMB.

Researcher: is that the first time you are using it?

Respondent 040: No that is not the first time I am using it, because I have knowledge about it but I have never used computer to do exam.

Researcher: but where have you used it before?

Respondent: I use at home.

Researcher: What of school?

Respondent 040: I use it at school, maybe when we have practical, during my junior class.

Researcher: at home, what do you do with it?

Respondent 040: I use it for typing and graphics work.

Researcher: How would you rate your experience level with using a computer on a day-to-day basis? Would you say you are a novice; you can barely do anything on a computer on your own? Or you are an intermediate, you sometimes need help to complete computer tasks? Or a professional: you rarely need help complete tasks?

Respondent 040: I am intermediate.

Researcher: Have you done UTME on paper before?

Respondent 040: No.

Researcher: before UTME, have you done other computer exams?

Respondent 040: No

Researcher: What would you say is your general opinion about paper exams and computer exams?

Respondent 040: paper exam it wouldn't be scary like computer exam, because paper exam, I am familiar with it, we use it in school. While computer exam, it is my first time of using it so the tension will be there.

Researcher: What was your experience during UTME, and was it different from a paper test?

Respondent 040: yes, very much different.

Researcher: Why

Respondent 040: the paper exam, you use your paper and biro, even though time is counting. And while using your pen sometime and writing on a paper, you can omit some spellings *(questions)* but on computer it is already set.

Researcher: what if it is the same question sets?

Respondent 040: there won't be any difference.

Researcher: What do you think about a computer exam before your UTME and after your UTME? What do you think now?

Respondent 040: I was scared at first, the tension was there even when I was going for the examination. And after it, I feel so bad because I wasn't expecting was, I scored in my examination.

Researcher: Do you think that is what you scored?

Respondent 040: Yes.

Researcher: What do you think would have improved your experience?

Respondent 040: maybe if I had calm down, and the tension is not there for me, I would have improved my experience.

Researcher: do you think your performance would have been the same if your exam were to be on paper?

Respondent 040: Yes.

Researcher: is there any other difference between what you have in your paper exam and what you have when you write your exam on a computer? Do you think there is another thing different about paper exams and computer exams?

Respondent 040: Nothing more.

Researcher: what would you say is your general feeling when you write a paper versus a computer exam?

Respondent 040: When I write paper exam, it is a normal stuff, so no tension, no fear. While my computer exam, it's not a normal stuff for me, so the tension is there.

Researcher: What do you think made you scared during computer exam?

Respondent 040: maybe how to operate computer, not everything I am perfect doing, when you make a mistake on the computer, it can waste time when doing computer exam. If there is nobody to help or assist.

Researcher: is there any other thing that made you scared?

Respondent: No

Researcher: What if any problem did you encounter during the exam?

Respondent 040: no problem.

Researcher: If you could choose the test mode to write your exam in, which one would you choose? Would you choose paper or a computer?

Respondent 040: computer

Researcher: why?

Respondent 040: because the computer is, in this world technology is as fast as possible. If it was the paper examination, the time will be counting and so that most time, you wouldn't have written anything before the time will…

Researcher: runout?

Respondent 040: Yes

Researcher: Any other comments about the computer exam or paper exam?

Respondent 040: computer exam is good, and it also helps students who don't have knowledge about how to use computer to have knowledge about it. And when in some areas, there are problems of technology there and if it can be improvised or bring down to that area. I think computer examination is the best.

Researcher: thank you very much for your participation.

INTERVIEW TRANSCRIPT 010

Audio ref: Respondent 010

Respondent Type: Public-Urban School.

Researcher: Where do you use a computer, and what do you do with it?

Respondent 010: In school and at home.

Researcher: What do you do with it?

Respondent 010: To play games, do look for some research.

Researcher: How would you rate your experience level with using a computer on a day-to-day basis? Would you say you are a novice, intermediate or a professional? Novice, you can barely do anything on the computer by yourself or an intermediate, you sometimes need help completing computer tasks, or would you say you are a professional you rarely need help to do things on the computer?

Respondent 010: I am intermediate.

Researcher: Have you done UTME on paper before?

Respondent 010: No

Researcher: Before taking UTME, have you done a computer-based test before?

Respondent 010: Yes.

Researcher: where and how many times

Respondent 010: In school, may like four times

Researcher: What is your opinion about paper-based and computer-based tests?

Respondent 010: computer-based exam, I prefer it more than paper

Researcher: Why do you prefer paper-based exam?

Respondent 010: Because it saves time more than paper.

Researcher: is there any other reason?

Respondent 010: No

Researcher: What was your experience during UTME, and is it different to when you write a paper exam?

Respondent 010: Yes, very different.

Researcher: Why do you think it is different?

Respondent 010: because before taking the exam, that is compute-based exam, I was very scared before taking the exam unlike the paper exam.

Researcher: What were your thoughts after the exam?

Respondent 010: I was relieved

Researcher: was it as bad as you thought, or is it as you expected?

Respondent 010: Yes, it was as I expected.

Researcher: What do you think can be done to improve your experience during computer-based exams?

Respondent 010: Going for computer training.

Researcher: Any other thing?

Respondent 010: No.

Researcher: Do you think your performance would have been the same if the exam were to be on paper?

Respondent 010: Yes

Researcher: Why?

Respondent 010: It will still be the same question.

Researcher: Is there any other difference between when you write your exam on paper and on a computer exam?

Respondent 010: before sitting for the computer exam, you will be more scared.

Researcher: What is your feeling during a paper-based exam? Are you relaxed, agitated or neutral?

Respondent 010: Neutral.

Researcher: if you have taken a computer-based test multiple, was your experience better, or was it after the multiple exams?

Respondent 010: better.

Researcher: How do you feel when you write a computer-based exam?

Respondent 010: Calm.

Researcher 010: Why do you think you felt calm?

Respondent 010: because the question was what I expected.

Researcher: If you could choose to do your exam on paper or computer, which one would you choose and why?

Respondent 010: computer

Researcher: why do you prefer computer exams?

Respondent 010: because it saves time.

Researcher: any other reason?

Respondent 010: you will concentrate more on that of computer.

Researcher: do you have any other comments about doing an exam whether on paper or computer

Respondent 010: No.

Researcher: thank you very much for your participation.

INTERVIEW TRANSCRIPT 021

Audio ref: Respondent 021

Respondent Type: Private-Urban School.

Researcher: Where do you use a computer, and what do you do with it?

Respondent 021: I use computer in the school for exam and practical.

Researcher: How would you rate your experience level with using a computer on a day-to-day basis? Would you say you are a novice, you barely do anything on a computer, or you are intermediate, you sometimes need help to complete computer tasks, or you are a professional, you rarely need help?

Respondent 021: Intermediate

Researcher: Have you done UTME on paper before?

Respondent 021: No.

Researcher: Have you done a computer-based exam before taking UTME?

Respondent 021: Yes

Researcher: Where did you do it and how many times?

Respondent 021: In school, about 5 to 8 times.

Researcher: What was your experience during UTME, and does it vary from paper-based tests?

Respondent 021: Yes, I was scared during UTME….

Researcher: But for the paper-based test, you were not?

Respondent: Yes

Researcher: What do you think made you scared?

Respondent 021: because ever since I have been writing paper exam, I use to feel normal that, at least this the stuff I have been doing frequently but when I was about to write JAMB (UTME), I was going for practice, I was like this is my first time, I don't know how this will be..

Researcher: What do you think about UTME before and after your exam? What are your thoughts?

Respondent 021: I thought of UTME like a normal exam that everybody does. But after the exam, after my first practice I realise that it is not as easy as I thought.

Researcher: What do you think could have been done to improve your experience when you took UTME?

Respondent 021: Practice more

Researcher: When you take a paper-based exam and when you take a computer-based exam, how do you feel?

Respondent 021: Like school paper-based exam?

Researcher: Yes, how do you feel when you take a paper-based exam, and how do you feel when you take a computer-based exam?

Respondent 021: When I took my UTME exam, I was scared, but paper-based exam is still something normal to me.

Researcher: You said you have taken a computer-based test multiple times. Do you feel better or worse after multiple exams, or was your experience the same all through?

Respondent 021: I feel better

Researcher: What do you think made you feel better?

Respondent 021: because as I am practicing, I realise that I am doing much more better.

Researcher: What problem, if any, did you encounter during your exam?

Respondent 021: Disconnection of computer- the computer just switch off all of a sudden. The computer might just hang and I will not be able to do anything, immediately my time is up, the exam too will be up. And that will actually affect me.

Researcher: Did this happen to you during your exam?

Respondent 021: Yes but I was writing my JAMB mock.

Researcher: When you are writing your mock exam, your computer went off, but during your actual exam, did you have any technical problems?

Respondent 021: No.

Researcher: When your computer went off during your mock exam, how did it make you feel?

Respondent 021: I was scared first, because of different stories I have been hearing about the kind of situation I am. I was like will I be able to finish and when we called them first, and there were like if you are one hour into the exam,, we would not be able to login again. Will I be able to login, would I continue my exam?

Researcher: If you could choose the mode you will write your UTME in, which would you choose?

Respondent 021: Computer.

Researcher: why?

Respondent: because I feel.., I feel much like, how would I put it, I feel very comfortable writing than that of paper.

Researcher: do you have any other comments about exams generally, either computer-based exams or paper-based exams?

Respondent 021: No

Researcher: thank you so much for your participation.

INTERVIEW TRANSCRIPT 037

Audio ref: Respondent 037

Respondent Type: Private-Rural School.

Researcher: Where do you use a computer, and what do you do with it?

Respondent 037: At home, to play games or watch movies. And I do help my mum with typing, she own a cyber-café.

Researcher: How would you rate your experience level with using a computer on a day-to-day basis? Would you say you are a novice, you can barely do anything on the computer on your own? Or you are an intermediate, you sometimes need help to complete computer tasks? Or a professional: you rarely need help to complete tasks?

Respondent 037: I sometimes need help

Researcher: Have you done UTME on paper before?

Respondent 037: No.

Researcher: before UTME, have you done another computer exam?

Respondent 037: No, only my school App.

Researcher: only on your school app on the phone, not on the computer?

Respondent 037: Yes.

Researcher: What would you say is your general opinion about paper exams and computer exams?

Respondent 037: computer exam, I feel scared, but for paper exam I am myself.

Researcher: What was your experience during UTME, and was it different from the paper exam?

Respondent 037: when I was doing UTME I was scared, it was different.

Researcher: is there any other difference?

Respondent 037: the duration have…

Researcher: do you feel like the time is shorter or longer?

Respondent 037: the time is shorter.

Researcher: What do you think about UTME using a computer before and after the exam?

Respondent 037: before UTME I thought I will not pass, but after the UTME I just let everything go, I have done it.

Researcher: why did you think you will not pass?

Respondent 037: because I was scared.

Researcher: is it because it is a computer exam or because it is a high-stakes exam?

Respondent: because it is a computer exam.

Researcher: you wouldn't have been scared if the exam were to be on paper?

Respondent 037: Yes.

Researcher: What would you say your experience during the exam was?

Respondent 037: my experience was good and bad?

Researcher: What do you think could have improved your experience?

Respondent 037: If I had sat down and relaxed.

Researcher: do you think you would have had the same performance on paper?

Respondent 037: I would have had a better performance.

Researcher: Why?

Respondent 037: because on paper I can go through it when I am done, but the UTME, I was not able to, because of the time.

Researcher: is there anything that made your experience during UTME different from paper exam?

Respondent 037: No.

Researcher: what would you say is your general feelings when you take paper test?

Respondent 037: paper test, my general feeling is that, I can do it.

Researcher: what of computer test?

Respondent 037: I will be nervous.

Researcher: Any other thing?

Respondent 037: no

Researcher: What do you think make you nervous during computer exam?

Respondent? No one around, just myself, I will be panicky.

Researcher: are you just panicky because there is no one around you?

Respondent 037: Yes.

Researcher: what problem, if any did you encounter during your exam?

Respondent 037: Most of the questions, I was not able to tackle it.

Researcher: Why?

Respondent 037: they were the ones have not been thought.

Researcher: any other problem? Is there any problem associated with the conduct of the exam?

Respondent 037: No

Researcher: If you could choose the test mode to write your exam in, which one would you choose?

Respondent 037: paper

Researcher: you will choose paper, why?

Respondent 037: it is a bit different, you know where to solve, for paper, there are places you can solve on the paper, but on the computer, you can’t.

Researcher: were you supplied with sheets you can work on?

Respondent: yes

Researcher: do you have any other comments about exams, whether paper or computer exams?

Respondent 037: on computer exam, my own is I should not be scared, on paper I can just relax, relax yourself.

Researcher: thank you very much for your participation.