CHAPTER ONE

INTRODUCTION

Background of the Study

The advent of the Fourth Industrial Revolution is introducing developments in Artificial Intelligence, Internet of Things, and other technologies in different sectors of our society, including education. This reality leads to a paradigm shift in which web-based cyber-physical environments will shape future learning environments making learning to become ubiquitous, and schools assuming new roles with systemic changes in communication, administration and management. The use of technologies aligned with pedagogical strategies and new methodologies leads to more-personalized smart learning systems (Eden, Onyebuchi & Adeniyi 2024). The landscape of smart learning systems has witnessed this tremendous shift from the traditional system of learning to smart education. Smart education also known as digital education or e-learning is an emerging learning environment that advocates the necessity for learners to learn in real-life situation technologies (Gros, 2016, Spector, 2014). With the help of cutting-edge real-world technologies like artificial intelligence, virtual reality, and the internet of things, smart education can accomplish its objectives of teaching, learning, research, and learning assessment while becoming more individualized, interactive, and accessible (Ray 2016). As stated by Zhu et al. (2016) The idea of "smart education" is based on two categories of technology: intelligent technologies and smart devices.

Smart devices represent those electronic devices connected to other devices that can operate independently and interactively to a certain extent in classroom instructional and learning contexts (Liu & Cao 2020). They are emerging instructional and learning tools such as flipped classroom, mobile apps, clickers' devices, interactive multimedia, audio devices, internet, telephone and VoIP, mobile gadgets, instructional television, computer games, teaching machines, interactive whiteboards and programmed instruction, etc., Edurne, Olatz, Ana, Jose, Nestor, (2020), with computing capacity and sensing function, which play a vital role in the classroom to create effective teaching and learning. There is a growing body of literature that recognizes the importance of smart devices use in the classroom settings (Liu & Cao 2020, Li, Wang & Ruan 2016, Bédard, Lison, Dalle, Côté, and Boutin, 2012). For example, Bédard, et al (2012) maintained that Smart devices are those latest technologies or devices and concepts used in classroom among students to students and students to teacher interaction. These tools have been making an increasing impact on the classroom and individualized instruction. Also, these tools have been used in science as an effective way of communicating ideas and concepts to students and have greatly improved students' performance especially those with special needs and slow learners (Oshinaike & Adekunmisi, 2012, Shan Fu 2013). It has also been pointed out in Kiboss, Ndirangu, and Wekesa, (2004) that the knowledge, skills and use of these smart instructional tools, can enable the teacher to perform some activities that most scientists employ to describe, predict and control the world around them. However, with the researchers' in-depth views of smart devices' working mechanisms in educational settings, the concept of "smart" in smart devices are not are not independent of intelligent technologies.

Intelligent technologies which have been categorized according to Ray (2016) on the basis of Internet of Things technology are used just like smart devices to create, analyze and personalize educational activities in an intelligent learning environment. According to Ikechukwu and Amos (2023), an intelligent learning environment comprises both smart devices and intelligent technologies to give room to a more personalized form of educational activities in smart educational landscapes. Smart schools are few examples of smart educational landscapes.

Smart schools are learning institutions that have been systemically reinvented in terms of smart teaching-learning practices and school management using smart devices and intelligent technologies to prepare smart students for the Information Age (Recalde, Palau, Agustí & Cebrián 2021). According to the authors, smart schools are institutions that integrates technology to enhance education, leading to personalized and improved learning. Current research on smart schools explores the integration of technology to enhance education, focusing on areas like personalized learning, online learning, and the use of technology for administrative tasks, while also examining the challenges and ethical considerations of implementing and leveraging such systems (Khan, Abbas, Alruwaili, Nazir, Siddiqi, &Alanazi, (2024). Research investigates how implementing and leveraging technology and AI, can enhance personalized learning experiences, focusing on increased engagement, improved student outcomes, and providing teachers with data-driven insights to better tailor instruction (Ayeni, Al-Hamad, Chisom, Osawaru & Adewusi 2024). Findings from Caroline, Oroh and Pada (2023) on the effectiveness of online learning platforms and the impact of technology on student engagement and learning outcomes, also revealed that learning experiences, facilitated by smart school technologies, can lead to significant improvements in standardized test scores. On smart classroom, the authors explore the use of interactive whiteboards, educational apps, and other technologies to create engaging and dynamic learning environments and reported that teachers can these smart technologies to provide targeted interventions and support to students who are struggling, leading to improved learning outcomes.

Apart from enhancing teaching and learning, Ayeni et al (2024) stated that these smart technologies can help in streamlining administrative tasks, such as attendance tracking, grade management, and resource allocation, freeing up educators' time for teaching and student support. Smart schools use technology to also facilitate communication and collaboration between teachers, students, and parents, creating a more connected and supportive learning community. Smart schools also explore the use of data analytics to monitor student progress, identify areas for improvement, and make data-driven decisions about teaching and learning.

In Enugu State Nigeria, Smart schools project has been inspired by all of these key areas of current research on smart schools as well as similar projects undertaken by other countries of the world (Attarana, Aliasb & Sirajc 2012). For example, Enugu State proposed the idea of smart schools in 2023 and it became operational in 2024. This was to improve current activities of smart school and attempts to provide a standard framework for development of smart education in the state. In addition, one of the major concerns was also to balance education facilities in rural areas and urban areas in order to reach educational justice. Reaching educational justice in this regard involves integration of sustainable IT infrastructures in both the rural areas and urban areas schools. By sustainable IT infrastructure we refer to the integration of physical systems and technologies that has different roles in the school system from facilitating teaching, learning, assisting the school management to assessment of students' performances in a smart and effective way (Shahzad, Walke, Dahat &, Kurmi 2023).

Assessment of students' performance is an essential part of educational practice, as it allows the measurement of the achievement of learning objectives by students, and improves the quality of the instructional needs and curricula (Arnold 2022). Assessment itself is a process designed to identify, collect and interpret information on the knowledge, skills and attitudes achieved by the students (Albert, 2010). It is one of the processes of measurement that leads to the appraisal of a good outcome from methods of teaching and learning in a school's curriculum. It is also part of the curriculum implementation process, the essence of which is to ascertain what has been learned by the students within a stipulated period and at a certain level of education (Ogbuanya and Usman, 2020). According to Phakiti and Steinhoff (2023) students' assessment is the process of administering tests, observation, or exams to the students to find out what they have learned from what they were taught. Similarly, Mbiriyakura and Kasowe (2022) emphasized that assessment is an important stage of curriculum implementation which typically take place at the end of the learning process, without which teaching and learning will remain immeasurable. This concept has undergone significant evolution over the past few decades, moving from an isolated activity taking place at the end of the learning process with the only purpose of giving a mark to the student to a continuous and systematic process directed toward making decisions for the improvement of the educational practices (Joshi, 2015). Considering the aims and the way assessment is administered, (Hassan, Tomalá, Coello, Silva (2024) maintained that assessment encompasses two broad spectrums of method - formative and summative.

In order to give students feedback on their progress and identify areas for improvement, formative assessment is a methodical and ongoing activity that takes place throughout the learning process (Joshi, 2014). Instead of assigning a grade, the focus of formative assessment is on giving the student written or verbal feedback from the instructor. According to Popham (2011), formative assessment is a deliberate process where teachers modify their ongoing instructional procedures or students modify their current learning approach based on assessment-elicited evidence of students' status. According to the author, this kind of evaluation can be created by having students complete self-assessment tasks and by having teachers observe the work that the students have completed.

On the other hand, summative assessments are used to provide a summary of the student's level of proficiency at the conclusion (or at a specific point) of the learning process through a specific grade or certification. The purpose of the assessment is to ascertain what students have learned at the conclusion of a particular lesson, unit, program, or school period. According to OECD/CERI (2008), it measures what students have learned at the end of a unit to promote students, ensure that they have met the requirements for certification upon completion of a level or school period, and identify candidates who have met the requirements to enter specific occupations. According to Hoover (2010), other applications of summative assessment include classifying and ranking students, giving grades to specific students, and assessing curricula and educational institutions (Hall, 2011; Hoover, 2011). However, the teacher takes on two distinct roles in both assessment methods. For instance, the teacher acts as a coach and facilitator during formative assessment to promote students' learning, but he judges students' accomplishments during a specific time period during summative assessment (Hassan, Tomalá, Coello, Silva 2024). It is evident from the discussion above that formative assessment is typically preferred over summative assessment since it gives students an opportunity to have an idea about their strengths and weaknesses as they proceed through a given course and provides teachers with pertinent information concerning the students' progress as well as the efficiency of the teaching methods and materials (Skutil & Maněnová 2021). In any case, assessment requires an objective judgment, far from mere incidental knowledge, intuitions and opinions.

As Enugu state smart schools are still in their prime, summative assessment is usually based on traditional examinations, tests, exercises, oral presentations and individual or group discussions. Successful conduct of assessments of these forms has been plagued by a range of examination malpractices, as learners employs various methods to bypass the test process (Birhanu 2018). This concern encompasses a variety of actions that undermines the integrity of the assessment process. These actions include introducing materials that compromise the fairness of the assessment, engaging in cheating by copying from unauthorized sources, colluding with examination invigilators to permit inappropriate behaviors within the examination hall, and engaging in impersonation by allowing someone else to take an examination on behalf of the intended learner.

To address these abnormalities, the ability to secure a web-based assessment system is an important element for a safe and supportive assessment in the Enugu state smart schools, where the teachers can carry out online assessment of students. To maintain this online culture, the smart schools must house robust information technology networks and multi-layered infrastructure systems with varied levels of access and connectivity. They must have extensive Wi-Fi support etc. That is when the theory that these multi-layered infrastructure systems that suggest students' assessments are improved (Garrison & Anderson, 2007). It is precisely this type of improvement for which a secured web-based assessment tools should be developed and one might assume that students' assessment should improve through the deliberate use of this development. If the Enugu state smart schools must be complete, it must be endowed with this sustainable students' assessment system and advance from Industry 4.0 in an efficient way.

However, during a need assessment to illuminate how the Enugu state smart schools are approaching their upcoming transformation in terms of adopting smart assessment monitor of learning progress, 7 head teachers from selected smart schools were interviewed. Thematic analysis focusing on technological and pedagogical innovations, management systems, inclusion, and sustainability identified some analogies with related research, pointing out that despite the technology advancements, Enugu state smart schools are far from implementing advanced technologies. For example, inclusion is the most-respected thematic element thanks to the existing government regulation. Sustainability is hardly considered because of a lack of economic resources and IT facilities (Finn et al. 2020, Mahmoudi, Nalchigar, & Ebrahimi 2008). According to the authors, the basic challenges of smart schools were the lack of necessary IT infrastructures orchestrated by high cost of equipment, government rules and regulations and the traditional structure of schools. These findings still remain valid as can be viewed from the assertions of Moorefield-Lang (2015) and Davidson & Ezeh, (2023) that, depending on the laboratory focus, certain equipment, resources and technology purchases can prove expensive and this can lead to non-availability of needed equipment / adequate technologies which can change the approach the teacher can adopt during students' assessment.

However, only one smart school in Owo, Enugu East considered themselves 'smart' and exhibited only smart learning practices with a traditional method to students' assessment. We came to the conclusion that while these smart schools are not yet equipped to handle the Fourth Industrial Revolution, its effects will depend on how mature the technology is, particularly when it comes to student assessment and learning outcome measurement. In order to assess students' knowledge in a more interesting manner, we therefore suggest creating an interactive web-based assessment platform.

Interactive web-based assessment refers to using the internet and web technologies to create engaging and dynamic assessment experiences, going beyond traditional static tests and quizzes to include interactive elements and immediate feedback. According to Kuleshov (2008), one technique that allows educators and trainers to create, plan, administer, and report on surveys, quizzes, tests, and exams is web-based assessment. It replaces the outdated pencil-and-paper testing methods and streamlines the entire exam cycle, including creation, execution, presentation, and archiving. It works well in both intranet and internet environments. Interactive web-based assessments, according to Gupta, Kajal, Joshi, and Sharma (2019), are tests, quizzes, or interactive tools that are given online with the goal of boosting user engagement and offering a more dynamic learning environment. These assessments, utilizes web technologies to create interactive messaging and immediate feedback mechanism.

Based on particular learning objectives, an interactive web-based assessment tool has been developed and published. For example, Akinsanmi, Agbaji and Soroyewun, (2010) developed an e-assessment platform for Nigerian Universities, focusing on the need for a web-based interactive application. Dahalan, and Hussain (2010) also developed a web-based assessment system to help teachers manage and prepare test questions, as well as assess students' learning. Ocampo and Panadero (2023) examined the educational features and challenges of web-based peer assessment platforms, finding benefits for both teachers and students, and Chua (2023) created a platform for full stack web development for auto assessment - a comprehensive solution for assessing HDL assignments using a modified judge framework, enabling interactive wave front visualization. Apart from the fact that these studies were faced with various challenges like overfitting Thapar K, Bijja H (2024)**,** context-specific and constrained by the use of small (and occasionally unreliable) batch sizes Bao X, Jiang D, Yang X, H, Wang H (2021), lack of sustainability Shukla AK, Muhuri PK, (2024)**,** non-integration with interactive question types Bao X, Jiang D, Yang X, H, Wang H (2021)**,** etc, development of an interactive web-based assessment tool as a proposed framework for Enugu state smart schools is totally non-existence.

Interactive web-based assessment tool is a tool that create interactive quizzes and assignments aligned with standard key interactive features like user authentication, question bank, assessment creation, interactive elements, automated grading, feedback mechanism, progress tracking and accessibility. In this study, we are interested in addressing the key question of what an interactive-web-based assessment scenario can offer to Enugu state smart schools and by how for the main aim of solving the problems and challenges of traditional assessment methods. To this end, we are proposing this assessment platform that can implement a secure login system to ensure only authorized users can access the platform, develop a robust question bank with various question types that can allow administrators to create and customize assessments using the question bank, incorporate interactive features, such as interactive messaging platform.

The platform can also implement an automated grading system to reduce manual grading time and increase accuracy, provide instant feedback to students, including explanations and suggestions for improvement, allow students and teachers to track progress and identify areas for improvement. We also make the platform accessible on various devices and browsers by following accessibility guidelines.

Technically, the proposed design has four components – front end, back end, database and API integration. We used a JavaScript framework (e.g., React, Angular, Vue.js) for a responsive and interactive interface for the front end. Research have shown that the use of JavaScript framework for the development of interactive interfaces makes the platform friendlier and interactive (Mokoginta Putri & Wattimena 2024). We also utilize a server-side programming language – PHP, to manage data and logic while developing the back-end. This is because the effectiveness of these programming languages have been tested to be suitable and a good approach (Goh, Kusnadi, & Pan 2022). Regarding the database, we choose a suitable database management system - MySQL, to store questions, assessments, and user data. MySQL have proven to be widely used in the development of databases that are reliable and sustainable in performance (Ivan & Tamara 2023).

The development methodology is Agile Development using the appropriate software development life cycle (Eze et al 2017). This is to ensure flexibility and rapid iteration (Jaana Nyfjord and Mira Kajko-Mattsson (2013). We employed a user-centered design where we involved stakeholders and end-users in the design process to ensure the platform meets their needs (Bayliss & Hardy (2012). To make sure the platform is reliable, safe, and operating as intended, we carried out extensive testing and quality assurance (Honest, 2019).

On the security considerations, we implemented encryption to protect sensitive data, such as user credentials and assessment results (Wang 2017). Also, we enforced strict access controls to ensure only authorized users can access and manage assessments (Mohamed, Dagmar, Hofer, Kung (2022). We then regularly updated and patched the platform to prevent vulnerabilities and ensure the latest security features. However, the policy implication of this development is that it will help ameliorate the challenges of the traditional assessment method.

Statement of the Problem

The need for an interactive web-based assessment platform is more felt in Enugu state smart schools despite the increasing dearth of ICT infrastructure to support the smart schools especially in the area of assessment. This is because assessment serves the purpose of testing the learners' level of knowledge within the context of teaching and learning process. Assessment can take the form of written or oral, providing teachers with a means to evaluate the degree to which learners have comprehensively understood the topics taught and effectively apply the acquired knowledge. To accurately assess the performance of the learners and evaluate the effectiveness of the teacher, it is imperative that assessments are properly safeguarded, and integrity upheld by both learners and teachers. That is to say, the assessment environment, the instrument and the test and or examination takers must meet the condition set for the successful conduct of assessments.

However, successful conduct of assessments has been plagued by a range of examination malpractices, as learners employ various methods to bypass the test process. The concern encompasses a variety of actions that undermines the integrity of the assessment process. These actions include introducing materials that compromise the fairness of the assessment, engaging in cheating by copying from unauthorized sources, colluding with examination invigilators to permit inappropriate behaviors within the examination hall, and engaging in impersonation by allowing someone else to take an examination on behalf of the intended learner.

These phenomenon has a significant influence in both instructors and educational institutions as these students are deemed unemployable in the world of work and this reflect negatively on their teachers, suggesting that they lacked the necessary qualifications. Additionally, these students may also cast doubt on the credibility and quality of their respective educational institutions, which may be perceived as substandard or lacking in proper academic standards.

In response to this, prior research endeavors have focused on the creation of web-based assessment platforms that only incorporated multiple choice questions which differs from this study. These multiple choice question format have exhibited vulnerabilities that often render them susceptible to bypassing or exploitation by individuals with malicious intents. Learners have devised strategies to circumvent the multiple choice system, enabling them to engage in impersonation activities with confidence. This called for the development of a more robust and resistant system that would pose significant challenge for unauthorized access or manipulation. Such robust and resistant assessment system is seen in our proposed interactive web-based assessment platform, which in addition to multiple choice question typ. This system significantly enhanced the confidence of learners taking exams and simultaneously decreased malpractices tendencies of students aptly. This significantly contributed to ensuring that students worked hard to learn and acquire the necessary skills and knowledge to effectively compete with their peers in the industry upon graduation, thereby establishing their teachers and schools as leaders in the field.

Purpose of the Study

The study's main goal is to create an interactive web-based assessment tool as a suggested integration framework for Enugu State, Nigeria's smart basic education schools. The study will specifically aim to:

1. Determine the software requirement specification for Interactive Web-Based Assessment Tool (IWBAT).
2. Design an architecture for the Interactive Web-Based Assessment Tool (IWBAT)based on the software requirement specification.
3. Determine the extent to which the architectural design is appropriate for the development of the Interactive Web-Based Assessment Tool (IWBAT)
4. Develop the examination Interactive Web-Based Assessment Tool (IWBAT) according to the architectural design
5. Determine the extent to which the developed Interactive Web-Based Assessment Tool (IWBAT) conform to the architectural design that guided the development.
6. Determine the extent to which the functionality of the developed Interactive Web-Based Assessment Tool (IWBAT) conform to the requirements that guided the design (Alpha Testing)

7. Conduct a user review on Interactive Web-Based Assessment Tool (IWBAT) developed to ascertain whether it conforms to the requirements that guided its design (Beta Testing)

Research Questions

The following Research Questions guided the study:

1. What are the requirement specifications for the Interactive Web-Based Assessment Tool (IWBAT)?
2. To what extent is the architectural design appropriate for the development of the Interactive Web-Based Assessment Tool (IWBAT)?
3. To what extent does the developed Interactive Web-Based Assessment Tool (IWBAT) conform to the architectural design that guided the development?
4. To what extent does the functionality of the developed Interactive Web-Based Assessment Tool (IWBAT) conform to the requirements that guided the design (Alpha Testing)?
5. To what extent does user review on the Interactive Web-Based Assessment Tool (IWBAT) developed conforms to the requirements that guided its design (Beta Testing)?

Scope of the Study

This study will be delimited to the development of Interactive Web-Based Assessment Tool (IWBAT) as a proposed framework for integration in the smart basic education schools in Enugu state Nigeria. The study will be carried out in the already completed Enugu state Smart Basic Education School located in Owo and Uhueze Nenwe in Enugu East and Aninri Local Government Areas respectively. The choice for using the two smart schools is that they may be better funded and may have purpose built ICT infrastructures. Grade 6 level students comprising of 150 pupils were used for the study. The choice for this level of students for the study was considered appropriate because the information required for the study could be obtained from them and will be used to make inference about the entire population of students.

The study also will focus on interactive messaging techniques of assessment. The choice for this form of assessment is to add value to literature since existing study on interactive web-based literature has always ended up multiple-choice-questions and we continue to see that without improvements.

Significance of the Study

The study's findings have theoretical as well as practical ramifications. The study's results should theoretically support the claims made by the Technology Acceptance Model (TAM), which highlights how external factors shape appropriate adoption and use of computer technology or ICT infrastructure in general in businesses and institutions (Davis, 1989). In essence, numerous researchers have employed the Technology Acceptance Model (TAM) to explain and comprehend people's acceptance and intention to use a range of information and communication technologies. Practically, the findings of this study is one that will raise the consciousness of pupils, school management, government ministries/agencies/policy makers, funding bodies/ external donors, curriculum planners, supervisors and teachers, future researchers and other stakeholders in Nigerian educational system to the fast changing learning environment due to ICT revolution and emergence of web-based assessment.

For the pupils, the findings of the study will raise their level of awareness by providing them reliable assessment platform that is devoid of fraudulent activities. This will provide them with the opportunity to effectively mitigate the underserved attribution of academic achievements to deceitful students. The findings will also bridge the gaps and identify the vulnerabilities in the traditional assessment method and expose them to those who should know about them and do something to take care of them.

The report of the study will be of benefit to smart school managements in being proactive in developing relevant strategies toward effective and sustainable electronic assessment platforms in their schools. This report would help in the planning for rapid diffusion of ICTs and provision of more electronic resources/environment in their schools.

Relevant government ministries/agencies such as the post primary school management boards, State basic education boards, National Information Technology Development Agency (NITDA) and donor (international/local) organizations/agencies will find the report of this study useful. For example, the post primary school management boards, the State basic education boards, the National Information Technology Development Agency (NITDA) will gain one or two useful insights from the facts and analysis in this work which will help them in the area of making sound policies regarding the web-based assessment usage by reflecting valuable ideas generated there from. again, the results of the study will also serve as an evaluation tool to the commission, a reference point to crosscheck and validate prior assumptions on the use of traditional assessment. This means that it will provide empirical data on the problems hindering the effective usage of traditional assessment that necessitated this development of a web-based assessment.

The incentives to invest in the development of web-based assessment platform of this kind, could be a likely benefit of the findings of this study. This is because, by revealing the extent of adoption, access and use of the web-based assessment tolls in the smart schools and the challenges involved, the findings of the study will create incentives from funding bodies, external donors and the individual researchers to invest in development of this valuable assessment platform.

Curriculum experts will also benefit from the results of this study. As curriculum experts review curriculum occasionally and irrelevant contents are discarded while novel and relevant ones are introduced, so will novel and relevant strategies be introduced. The findings of the study will provide data for evaluating existing curricula on the introduction of relevant strategies in the teaching and learning system in the schools. This may form the basis for consortium formation agreements among the school or revision of an existing consortium agreements to enhance better adoption of web-based assessment tools and information resource sharing.

The supervisors and teachers of primary and secondary schools are also expected to find the outcome of the study useful. The research outcome will inform them about the challenges faced by the students regarding assessment and how to address those challenges.

It is also expected that the findings of the study would add to the data pool on this topical subject. This is a major significance of the study as data to be generated from the study will add to the pool in respect of the interactive web-based assessment technologies. Future researchers and other scholars interested in this topic will also find the outcome of this study useful for their study.

CHAPTER TWO
LITERATURE REVIEW

This chapter presents a review of related literature to this study. The review is organized in the following order:

Conceptual Framework

Smart Basic Education Schools

Assessment in Education

Interactive Web-Based Assessment

Examination System in Nigerian Schools

Software Development Life Cycle

- Iterative Model
- Software Requirement
- Design Phase
- Development Phase
- Test phase/ Alpha Testing
- Review Phase/Beta Testing

Schema

Theoretical Framework

- The Technology Acceptance Model (TAM)
- Diffusion of Information

Related Empirical Studies

Summary of Literature Review

Conceptual Framework

A study of this nature involves the use of some basic topical concepts. It is therefore for the sake of clarity and simplicity that the researcher set out to give a somewhat brief description of these concepts as perceived by some theorists and earlier researchers beginning with the criterion variables itemized above.

Smart Basic Education Schools in Nigeria

The literature shows the terminology of 'smart school' has been used in limited countries but most others use these terms: 'ICT usage in schools' and 'ICT integration in schools'. This research has defined a new term as 'smart school system', which refers to all components of the smart schools including technology, people, process and education material.

Smart school is a learning institution that has been systemically reinvented in terms of teaching-learning practices and school management in order to prepare students for the Information Age. Information Technology or IT, as an important pillar of smart school system, has different roles in the system from facilitating teaching and learning activities to assisting the school management. The aim of the review is to investigate the smart school activities in Nigeria in order to propose an IT framework for improvement of the smart school system in Enugu State Nigeria. Although in recent years some efforts have been done for developing smart schools in Nigeria, there is still no comprehensive solution for development of smart school system to be referred.

The smart school project in Enugu state Nigeria has been inspired by a similar project undertaken by the Malaysian Ministry of Education (Attaran & Siraj, 2010). For example, in

Malaysia, the idea of smart schools was proposed in 1997 and became operational in 1999. According Research objectives and significance of the study are discussed for a smart school to achieve its educational objectives, these teaching and learning concepts. The researcher hopes this study will help ministry of education of Nigeria to improve current activities of smart school and attempts to provide a standard framework for development of smart school. In addition, one of the concerns is to balance education facilities in rural areas and urban areas in order to reach educational justice in Nigeria. The status quo of smart schools in Nigeria was examined and lack of IT infrastructure standard for smart school systems was addressed. According to research by Wan Ali, Mohd Nor, and Alwi (2009), the biggest issues teachers encountered when integrating ICT in Malaysian smart schools were time, course content, and technical issues. Mahmoudi, Nalchigar, and Ebrahimi (2008) discovered that the traditional structure of Nigerian schools and the absence of relevant rules and regulations in the Ministry of Education were the main obstacles facing the country's smart schools.

Teachers and students in Nigerian smart schools do not have a positive attitude toward teaching and learning, according to Attaran and Siraj (2010). Additionally, their study's findings showed that in order to improve the effectiveness of smart schools, more equipment should be given to educational institutions, and teachers should take advantage of additional training opportunities and ICT courses in addition to receiving rewards for their involvement. However, the smart school project in Nigeria's Enugu state was started in 2023 and was based on the Malaysian model. In 2024, the state Ministry of Education carried out the project's pilot phase, converting 260 wards' worth of schools into smart schools. This project seeks a Master Plan which was chosen by education institution for development of ICT in Education. In fact, officials of Education gradually came to a deeper understanding of global developments and the role of ICT in development (Attaran, 2011). This led to the development of ICT in this phase as a general direction taken by the managers of education. In 2024, the road map of smart schools which was developed by the Enugu state Ministry of Education, have been mentioned as one of the key requirements of knowledge-based societies through the development of knowledge and entrepreneurial skills of students in these schools.

Objectives and activities of the schools are based on the Enugu state smart school but the sub structure are not different from what is obtained in other advanced countries. The project was expanded to other school districts after "The Road Map of the Smart Schools" was published in 2024. The project appears to be based on the implicit premise that, like in many other nations, ICT integration will become commonplace if schools are outfitted with computer hardware (Thang, Hall, Azman, and Joyes, 2010). "Financial investments for the educational use of ICT had not been in line with high expectations," according to the Second Information Technology in Education Study (SITES). According to previous sections, this research attempts to provide a framework for ICT infrastructure of smart school in relation to assessment of students' performance.

Assessment in Education

In order to evaluate curriculum, school quality, and system performance, as well as the quality of teacher instructional activities and student learning experiences, assessments are essential. Assessments serve as a tool for summative accountability evaluations of educators, educational institutions, and government agencies as well as for formative improvement of instruction and learning. Given its immense power, it would seem beneficial to have a more nuanced understanding of its past, present, and potential. We start this overview with a quick historical tour that starts with assessments from the past three millennia and continues into the future, which is already happening in a variety of settings.

Between 2,500 and 3,000 years ago, the Chinese Imperial examination system was first documented (China Civilization Centre, 2007). In the vast Chinese empire, that system was used to find and reward talent wherever it was found. It was intended to find students with high levels of literacy and memory skills meritocratically so they could run the Emperor's bureaucracy of command and control over a sizable population, as opposed to depending only on recommendations, bribery, or nepotism. The system used standardized tasks to accomplish those objectives (e.g. G. finishing an essay in accordance with Confucian principles) under monitored conditions to guarantee performance comparability and integrity (Feng, 2022). The system consisted of a graduated sequence of tests that got harder and harder until nobody could receive the highest grade at the end since it was only given to the Emperor. In addition to receiving jobs with significant financial benefits, successful candidates were also publicly recognized on examination lists and granted the ability to wear particular colors or badges that indicated the level of examination they had passed. These factors were part of the justification for this extensive technology. It should come as no surprise that there was a thriving industry of creating cheat materials given the enormous prestige and potential for social advancement through scholarship. G. tiny books that imitated classic Confucian texts) and identifying dishonest people (e.g. G. groups of invigilators sitting in tall chairs with a view of the desks where candidates worked (Elman, 2013).

The literary and oratory remnants of the Roman Empire, such as schools of grammarians and rhetoricians, on the other hand, gave rise to European educational assessment, according to Encyclopedia Brittanica (2010a). Schools were established simultaneously in a number of European cathedrals, monasteries (particularly Benedictine monasteries), and episcopal schools. Church priests were expected to learn Latin under Charlemagne in order to properly interpret the Bible, which resulted in more sophisticated academic and religious instruction. As early Renaissance European society evolved, schools were established under the direction of a bishop, cathedral official, or even from nonreligious guilds to individuals judged sufficiently qualified to instruct. To guarantee safe travel and freedom of thought, these schools granted their teachers and students certain rights and protections. Many of the clerical practices of reading significant texts and scholars assessing the quality of learning by comparing student performance in oral disputes, debates, and arguments to the opinions of higher ranked experts were adopted by European universities in the 1100s. In the centuries that followed, oral disputes were supplemented with written assignments and performances to assess the caliber of learning outcomes. However, as with the Chinese Imperial system, evaluation was predicated on the knowledge and discretion of more senior academics or officials.

These systems were established to satisfy the demands of either society or religion for numerate and literate scholars, bureaucrats, and thinkers. Further education, or even basic education, was typically a scarce and rationed resource. Standardized tests were used to choose applicants in a largely meritocratic manner, even if they were just the procedure and not the task or scoring. Students and families participated in these processes because a successful education offered them hope of escaping hard labor and poverty. As a result, schooling served as preparation for the final exam, assessments during the schooling process were merely imitations of final assessments, and assessment was essentially a summative evaluation of the student's abilities.

More effective ways to reduce the workload associated with hearing memorized recitations were sought after as schooling and higher education expanded throughout the 1800s (Encyclopedia Brittanica, 2010b). As a result, leaving exams were made a prerequisite for admission to learned professions (e.g. G. teaching), the public sector, and higher education. More effective methods of gathering information were developed as more students attended universities in the 1800s, particularly the essay exam and the practice of responding in writing without assistance. As students finish their written exam papers under time pressure and scrutiny using multiple-choice test methods, this tradition is still evident in the well-organized rows of desks in exam rooms. Due to this factor, standardized machine-scored tests have become more and more common throughout the century for graduate school admission, university admission, and even school evaluation. The process by which items are scored in two ways (i.e. e. whether correct or incorrect), statistical modeling in classical test theory produced simple and recognizable numbers (e.g. G. standard error of measurement, reliability, mean, and standard deviation; Clauser, 2022). In order to guarantee the validity of scores and their interpretation, validation techniques have become more intricate and multifaceted as the 20th century has gone on, and the concepts of validity have expanded (Zumbo and Chan, 2014). Among these were item response theory, factor analysis, scale reliability, equating, norming, and standard setting (Kline, 2020). It is important to note that statistical techniques for analyzing test results originated in the early days of psychology. The field of educational testing started to resemble statistics more and more as psychometric techniques grew more sophisticated. In fact, according to Cronbach (1954), the field of psychometrics (i.e. e. statistical assessment of psychological phenomena) was becoming disconnected from psychology, which was the field most likely to use psychometric research and methods. It's interesting to note that although assessment is widely used in the educational field, few teachers are proficient in the statistical techniques required to evaluate their own exams, let alone those administered by central authorities. It is true that very few teachers receive training in statistical test analysis techniques, even fewer comprehend them, and nearly none apply them.

Assessment is, of course, more than just a series of questions or a scored task. It is a valid attempt to operationalize a sample of a curriculum domain, construct, or content. The difficulty with assessment stems from the paradox that the content that is easiest to test and grade is typically the least demanding or valuable in any field. Learning objectives for K–12 education, and even more so for higher education, demand that students do more than simply memorize and repeat lists of terms, facts, or data points. Deep processing requires the recall of specific data pieces, but this is insufficient. Pupils must demonstrate critical thinking, creativity, problem-solving, analysis, and synthesis. Evaluating these abilities is very challenging and complex. However, it is simple to reduce society's valued goals to that when it is necessary to show that teachers are effective and that schools are accomplishing society's goals and purposes. As a result, the high-stakes exam is used as the curriculum in many societies. This would not be such a bad thing if we could be certain that the test's content reflected what society actually desired; this is known as measurement-driven reform, as defined by Resnick and Resnick (1989). However, studies conducted over long periods of time since the mid-1900s have demonstrated that a large portion of the material we test does not improve students' learning (Nichols and Harris, 2016). Scriven's (1967) work on the philosophy and principles of evaluation was a significant development in the middle of the 20th century. The difference between formative evaluation, which occurs early enough in a process to influence its end points, and summative evaluation, which establishes the quantity, caliber, and merit of the output of the process, was one of the evaluation's most potent features, according to him. In education, the concept of formative evaluation was swiftly adopted to describe assessments that teachers used in the classroom to determine which students needed to learn what next (Bloom et al. (1971). High-stakes end-of-unit, end-of-course, or end-of-year formal exams that evaluated the caliber of student learning and achievement in a summative manner contrasted well with this. Scriven's formative evaluation led to the use of assessment procedures early in the educational course of events to inform students about what they needed to learn and teachers about what they needed to teach, whereas assessment as psychometrically validated tests and examinations historically focused on the summative experience.

However, the distinction between formative and summative has changed from one of timing to one of type since the late 1980s (thanks in large part to Sadler, 1989). Formative assessments were initially limited to classroom interactions that were informal rather than formal tests. The UK Assessment Reform Group (2002) expanded on this viewpoint by establishing the fundamentals of formative assessment globally. According to Brown (2013), 2019, 2020a, those classroom assessment procedures placed a lot more emphasis on what might be considered classroom instruction. Instead of administering tests, teachers engaged with students in real time, in the classroom, using questions and feedback to guide them toward the learning objectives set out at the start of classes or courses. Accordingly, assessment for learning has evolved into a kid-friendly strategy for engaging students in their education and producing rich, significant results without the burdensome demands of testing (Stobart, 2006). The main advantage of this strategy was that it provided an alternative to the high-stakes standardized assessment tasks that were part of the national curriculum in England and Wales for students ages 7, 9, 11, and 14 (i.e. Wherrett, 2004; Key Stages 1–4. As access to education expanded globally during the 20th century, there is worry that high-stakes test scores merely serve to reinforce existing social status and hierarchy (Bourdieu, 1974). According to this viewpoint, tests are elitist instruments rather than neutral ones (Gipps, 1994). Unfortunately, when assessments have significant consequences, much higher proportions of disadvantaged students (e. G. minority students, students who are new to the language used for assessment, students with special needs, students who struggle with reading, etc. do not enjoy these advantages (Brown, 2008). This contributed to the creation of the use of excellent formative assessment to quicken the learning process for underprivileged pupils. However, variations in group results do not necessarily indicate that tests are the issue; rather, they may indicate that the school system's distribution of educational materials is biased toward certain cultures (Stobart, 2005). This would serve as justification for system monitoring tests like the National Assessment Program Literacy and Numeracy in Australia, the Territory Wide System Assessment in Hong Kong, and the National Assessment of Educational Progress in the US. The difficulty lies in keeping an eye on a system without placing blame on people who have been disappointed by it. In addition to assessing student learning, Key Stage assessments were implemented to reassure the public that educators and educational institutions were meeting significant educational objectives. This assessment approach focused on teacher and school accountability rather than student accountability (Nichols and Harris, 2016). Particularly in the US, the choice to use student learning assessments to rate schools and teachers was imitated by the No Child Left Behind law, several state accountability tests, and even cutting-edge assessment initiatives like PARCC and Race to the Top. It should be mentioned that teachers are evaluated using standardized tests and schools is genuinely a worldwide issue, not just in the United States and the United Kingdom (Lingard and Lewis, 2016). In order to prove school efficacy and satisfy accountability standards, testing evolved into a summative assessment of educators and school administrators.

Experts in various disciplines currently have quite different perspectives on assessment. Psychometricians typically use test score statistical modeling to define assessment. Assessments are used by psychologists to diagnose and characterize the needs or strengths of their clients. While teachers emphasize assessment as interactive, on-the-fly experiences with their students, parents understand assessment as test scores and grades, and school leaders typically view assessment as jurisdiction or state-mandated school accountability testing (Buckendahl, 2016; Harris and Brown, 2016). Psychometrics, statistics, curriculum, classroom instruction, and assessment technologies have all become distinct fields from psychology. This short history, which brings us into the early 21st century, demonstrates how educational assessment is influenced by a variety of disciplines that frequently do not communicate with or even teach one another. It is now possible to separate the statistical analysis of testing from psychology and education, psychology from curriculum, teaching from testing, and testing from learning. As a result, there are numerous significant factors that influence the efficient use of educational assessment that are distinct from one another as we move into the present.

The vast amount of data made available by online testing and online learning behaviors has currently captured the attention of the educational statistics community. With machine learning and artificial intelligence algorithms, the field of computational psychometrics aims to integrate statistics from educational testing into the dynamic analysis of large data, potentially producing a "black box" of complex statistical models (e.g. G. neural networks) that citizens, educators, administrators, and students are unable to comprehend (von Davieret al. (2019). Since computing technologies have been developed, item creation (Gierland Lai, 2016) and performance scoring (Shin et al. 2021), in addition to tailoring the test's content based on the test-taker's performance (Linden and Glas, 2000). The Covid-19 pandemic has quickly made online and distance testing a common practice with concerns about how technology is used to ensure the integrity of student performance (Dawson, 2021).The ecology of the classroom is not the same as that of a computerised test. This is especially important when the outcome of a test (irrespective of medium) is not very relevant to a student (Wise and Smith,2016). Performance on international large-scale assessments (e.g., PISA, TIMSS) may be important to government officials (Teltemann and Klieme, 2016) but these tests are not very useful for individual learners, but government responses to PISA or TIMSS results may create policies and initiatives that trickle down on schools and students (Zumbo and Forer, 2011). Accordingly, test-taking motivation on tests with state-level consequences may be comparable to that of tests with personal consequences in East Asia, depending on the educational and cultural context (Zhao et al. 2020), but significantly lower in a democracy in the West (Zhao et al. 2022). Therefore, the results of psychometric analysis are likely to be faulty if there is no assurance that students are putting their best effort into any educational test (Thorndike, 1924). Though this feature is not very common, it is now possible to monitor a student's decreased or waning effort during an actual test event under computer testing conditions and support them with a supervising proctor (Wise, 2019). Many teachers and students now accept online or remote teaching, learning, and assessment, particularly in light of our educational responses to the Covid-19 pandemic. This is obviously appreciated by some families, as it allows their kids to advance quickly without being constrained by their peers or the teacher. For these families, continuing their education online would be viewed as a good thing. On the other hand, depending exclusively on a computer interface for evaluation or instruction could dehumanize the fundamentally human process of learning and teaching. Margie pictured what it must have been like to attend school with other kids, as Asimov (1954) outlined in his short story about a future society where kids are self-taught by machines.

Because it is likely to be socially unjust, Brown (2020b) has argued that the option of a de-schooled society through computer-based teaching, learning, and assessment is extremely unappealing. Human development is influenced by the educational experience. We acquire knowledge through education (Bloom, 1976), experiences that are culturally specific (Cole et al. biogenetic factors (Inhelder and Piaget, 1958), interpersonal interactions with peers and adults (Vygotsky, 1978; Rogoff, 1991), and others. Through education, we can access settings where these various processes help create the types of citizens we desire. Therefore, we must have faith in the ability of shared education to do more than just accelerate children's learning and knowledge acquisition—it also makes us more human.

The conflict between in vitro and in vivo biological research is reflected in this quandary. Organisms do not always behave the same in the controlled environment of a test tube (vitro) as they do in the complex environment of human biology (Autoimmunity Research Foundation, 2012). According to Zumbo (2015), this analogy has been used in educational assessment to show that student performance on computer-mediated tests may not be a reliable indicator of how well students perform in face-to-face or classroom settings. Hattie's (2004) ROPE model, which holds that the different facets of human motivation, belief, strategy, and values interact as threads spun into a rope, captures the complexity of human psychology. This indicates that it is challenging to disentangle the different elements analytically and pinpoint elements that separately account for learning objectives. As it happens, Marsh et al. (2006) demonstrated that nearly all of the numerous self-concept and control beliefs that are used to forecast PISA test performance have relationships to achievement that are less than r=0.35. Rather, performance is influenced by the interplay of motivation, learning beliefs, intelligence, assessment, self, attitudes toward and toward others, subjects, and behaviors. Among the elements that establish growth-oriented pathways and strategies are deep learning (Biggs et al., 2000), mastery goals (Deci and Ryan, 2000), and others (Boekaerts and Niemivirta, 2000). beliefs, flexible intelligence (Duckworth et al., 2001). beliefs, internal, controllable qualities (Weiner, 1985), and improvement-oriented views regarding evaluation (Brown, 2011), working hard (Wise and DeMars, 2005), staying away from dishonesty (Murdock et al. trusting colleagues (Panadero, 2016), and being realistic when assessing one's own work (Brown and Harris, 2014). The deactivating and maladaptive attitudes, behaviors, and beliefs that undermine learning and protect the ego contrast with all of these adaptive aspects of learning. This indicates that psychological research is important for comprehending assessment results and that variance in student achievement cannot be adequately explained by a single psychological construct. While nearly every construct reported in educational psychology appears to contribute positively to improved performance, it appears that we are still unable to pinpoint which particular processes are most important for improving performance for all students across the ability spectrum. The problem facing educational psychology in an assessment context is determining which constructs are most crucial and effective prior to, during, and following any assessment process (Mcmillan, 2016) and how best to operationalize them.

There is currently a lot of interest in using "big data" from computer-based tests to look more closely at how students complete tasks. As part of their process data collection, numerous extensive computer-based testing programs gather, use, and report on test-taker engagement (e.g. G. the National Assessment of Educational Progress4 in the United States. Data about which options were clicked, in what order, which pages were viewed, and when these actions occurred are provided by these test systems. The use of big data in educational assessment is fraught with difficulties. First and foremost, computerized evaluations must record the procedures and goods that are important to us. In order to generate the process data itself, we must have a clear theoretical model of the underlying cognitive mechanisms or processes (Zumbo et al. (in press). Second, we must remember that theory and process insight are necessary to comprehend data; data cannot explain itself (Pearl and Mackenzie, 2018). Analyzing log files can provide some information about effective vs. unsuccessful tactics, after the data were analyzed theoretically to develop a model of how a problem ought to be solved (Greiff et al. (2015). Even if a problem cannot be solved, persistence is linked to overall performance, according to data logs that demonstrate effort and perseverance on a challenging task (Lundgren and Eklöf, 2020). However, data alone won't tell us how and why students are succeeding or what kind of instruction might be necessary to motivate students to stick with the scientific method of changing one variable at a time.

Only item difficulty, item discrimination, and item chance parameters can be statistically modeled in psychometric analyses of assessments to estimate individual ability (Embretson and Reise, 2000). Score estimation excludes all other psychological aspects of how students interact with their surroundings and with themselves. In order to provide appropriate instruction, feedback, support, and questioning, teachers in real classroom settings try their best to take individual motivation, affect, and cognition into account. These factors, however, differ in their nature depending on time (cohorts), place (cultures and societies), policy priorities for education and evaluation, and family values (Brown and Harris, 2009). Accordingly, what makes an assessment valuable for guiding instruction in a classroom setting (i.e. e. determine who needs to be taught what next) must be extremely sensitive to contextual and individual factors and must be continuously evolving. If psychology, curriculum, psychometrics, and technology are kept apart, this will be challenging. Interaction between these various fields seems very desirable, but there is no guarantee that advancements in psychometric testing technology will be applicable in classroom settings where teachers must relate to and track students' progress in all significant curriculum areas.

Students' thoughts and feelings during assessments are frequently treated as a sort of "black box," suggesting that the processes are unknown or opaque. I have previously used this method to look at how students respond to self-assessment questions (Yan and Brown, 2017). In engineering, on the other hand, a black box means something quite different. The fundamental ideas of aeronautics that pertain to flight (e.g. A. engine power, pitch and yaw positions, aileron settings, etc. are well understood; without them, flight would not be possible. These crucial variables' values are recorded by the airplane's black box, which also records the only unknown (i.e. E. At the point of interest, the values were black. The fundamental concepts that underpin learning and achievement must be agreed upon if we are to keep using this metaphor to explain what occurs when students are assessed, after that, we must all agree on the fundamental ideas that underpin learning and success. It appears that everything is connected and that everything matters in our current circumstance. If we develop and deploy sensors that are suitable for the constructs we believe to be most crucial, data science might be able to help us separate the wheat from the chaff. It's possible that eye tracking and mouse click timing measurements are related to significant underlying mechanisms, but at this point, data science in testing essentially consists of crunching "easy to get" numbers and hoping the results have some significance.

Interactive Web-Based Assessment

Interactive web-based assessments are online evaluations that offer engaging and dynamic experiences for learners, often utilizing technology to present questions, record responses, and provide feedback. They replace traditional pencil-and-paper assessments with digital formats, suitable for various educational settings. According to Kuleshov (2008), this approach makes it possible for instructors and trainers to create, plan, administer, and report on surveys, tests, quizzes, and exams. It replaces outdated pencil-and-paper testing methods and streamlines the entire exam cycle, including creation, execution, grading, presentation, and archiving. It works well in both Internet and intranet environments.

Faculty and students have found it beneficial to teach and reinforce science topics using web-enhanced curricula depending on particular learning objectives. This chapter reviews the quick construction of a web-enhanced evaluation platform as a suggested innovation to the traditional teaching method in Enugu State's smart schools. The article's primary focus is a comprehensive overview of the planning, development, and application of a computer-aided system for teaching basic schools science courses (physics, biology, mathematics, and chemistry) with sufficient laboratory experience. These include (i) evaluating and choosing a learning management system; (ii) adjusting the computerized course curriculum to a web-based format; (iii) creating simulations (virtual labs) and animated illustrations if necessary; (iv) creating a threaded discussion board where all students are expected to participate in discussions moderated by a professor; (v) setting up computerized tests; and (vi) summarizing and analyzing student feedback.

Examination System in Nigeria

In Nigeria, the examination system plays a pivotal role in assessing students' knowledge and skills at various levels of education. The system encompasses a range of standardized tests, including primary school leaving exams, secondary school certificate examination, and tertiary institution entrance exams. Eze, Chinedueze & Bello (2018) asserted that examinations have been the preferred mode for accessing learners' competence in Nigerian schools from primary to tertiary institutions. Examinations could be oral or written, handwritten or computer based. It could take the form of essays, multiple choice, open book examinations, short examinations, or case study. Examinations are conducted at the end of a teaching/learning exercise and questions capture concepts taught. Examinations are conducted at the end of a teaching/learning exercise and questions capture concepts taught. Examinations will examine the knowledge level of students who attended classes and ensure that transparency and integrity are achieved in the conduct of the examination.

An examination should consider three key attributes: content validity, which assesses the test's ability to accurately measure what it intends to; reliability, which measures the consistency and dependability of students' scores; and objective, which ensures that the test scores are primarily influenced by the students' performance rather than the personal biases of the exam creator (Kinyua & Okunwa, 2014). Examinations emphasize hard work, learning progress, student independence and reward for excellence. Students are expected to sit for examination at the time allotted and submit their answers promptly. Cheating and such vices are prohibited in examinations and could lead to varied sanction depending on the laws guiding the conduct of the examination.

The manual examinations were very cumbersome due to large classes and the stress involved in physically marking scripts and this gave rise to the computer-based examinations (CBE) which was faster and easier to manage (Gonzalez, 2018). He further opined that the results from CBE were readily available once the examinations are over. The manual and computer-based examinations faced similar challenges ranging from cheating, bringing in unauthorised materials and impersonation. These challenges posed a major hindrance to the successful conduct of credible examinations. The difficulties were encountered in national tests such as the West African Examination Council (WAEC) and the Joint Admission Matriculation Board (JAMB), as well as in institutional examinations administered by various higher institutions.

The examination system in Nigeria encounters several obstacles, such as the problem of exam misconduct, insufficient infrastructure, and differences in educational resources between urban and rural regions. Addressing these difficulties requires the utilisation of technology to monitor exams and the enforcement of more stringent procedures to discourage cheating. The problem of examination impersonation is often caused by parents who provide financial incentives to ensure that their children pass exams, or even hire someone else to take the exams on behalf of their children. This practice leads to issues of impersonation and various negative consequences for the education system. Additionally, when it comes to defending their certificates, these students who have not acquired sufficient knowledge and skills become the resulting problem (Nwogbo & Ugwoke, 2021). Additional factors contributing to the issue include an excessive focus on certificates in Nigeria, a lack of confidence in passing exams due to inadequate preparation, and student laziness. Many students have limited time for studying, prioritise social activities such as attending parties, and form groups that engage in inappropriate behaviours.

Oloyode (2021) asserts that it is vital to protect the future of education in Nigeria, and JAMB will have a pivotal role in this revolutionary endeavour. As a result, biometrics were implemented in all JAMB tests and CCTV cameras were used to monitor centres. Additionally, centres and institutions that violated the rules were banned. JAMB successfully implemented a unimodal strategy, which significantly reduced incidences of impersonation. However, it was unable to totally eradicate it as students found ways to bypass the system for their own selfish motives. This has become a new difficulty since certain centres are also colluding with impostors to carry out their activities without hindrance due to the exchange of money.

The JAMB model became a path the tertiary institutions quickly accepted by first implementing the post-UTME for prospective students and afterwards the computer-based examination for courses with large class size. This was to ensure that examinations were promptly graded, and results turned in for the next session. Students quickly took advantage of the porous nature of the new system and cases of a student writing for more than one student became an issue. On the other hand, some of the students noticed that some lecturer couldn't stand the stress of checking every system to confirm if the examination taker is the authentic person meant to be writing the examination in the institution.

Institutions to the use of unimodal biometrics by collecting the biometrics of students and using same for admitting students for examination. Students observed the stress encountered in calling in students and verifying their identities and the not too strict stance exhibited by clearance officers towards the end of the examination and the lapses which could be taken advantage of. This led to a need for a more secured system which would reduce the human factor to the barest minimum and ensure that only bonafide examination takers are allowed to sit for the examination and impersonator would be denied access to writing examination.

Software Development Life Cycle

The necessity for automating different activities and satisfying structural procedures for the transition from a manual system to an automated system to an automated system gave rise to t he concept of the System Development Lifecycle (SDLC) (Kute, & Thorat, 2014). The Software

Development Life Cycle (SDLC) refers to the systematic process of designing, modifying, and implementing computer systems, as well as the various models and approaches employed in their development. It also involves the systematic framework required to develop software without any glitches, user-friendly and bug-free.

Several authors have presented a summary of the fundamental nature or objective of the Software Development Life Cycle (SDLC) (Jindal 2016). Laplante and Kassab (2022) asserted that the core tenets of the SDLC are to comprehend users' demands, create a strong design, develop software flawlessly, and put in place a usable system that meets users' needs. According to Battina (2021), the Software Development Life Cycle (SDLC) facilitates the early identification and resolution of security vulnerabilities and system configuration issues, leading to reduced expenses in implementing security measures and addressing vulnerabilities.

The Software Development Life Cycle (SDLC) is a methodology used to create high quality software within a defined timeframe, tailored to meet the requirements of end user (Akinsola, Ogunbanwo, Okesola, Odun-Ayo, Ayegbusi, & Adebiyi, 2020. The product's quality is upheld by the implementation of the Software Development Life Cycle (SDLC). Each development model encompasses several processes such as requirements collecting and analysis, system analysis, system design, coding, testing, and implementation. The choice of the SDLC model is contingent upon the developer or the group of developers (Nugroho, Waluy, & Hakim, 2017). Multiple software development life cycle models are assessable, such as the waterfall model, the V-shaped model, the spiral life cycle, and the iterative design model. Each of these models leads the project through a sequence of beginning stages. At a macro level, all models encompass a consistent set of five software development phases.

Iterative Design Model: The iterative Deign approach created by Winston Royce in 1970 is a solution to the inefficiencies and issues observed in the waterfall approach. (Morgan, 2018). The iterative design model is a specific approach to realizing the software development life cycle (SDLC). It involves starting with a basic and simplified version of the system, and then gradually adding complexity and expanding the range of features until the final system is fully developed (Bucki & Suchanek, 2019). When describing the iterative process, the term "incremental development" was frequently and interchangeably used. This term refers to the gradual modifications made during the design and implementation of each new iteration.

The iterative approach commences by initially implementing a limited portion of the software requirements and subsequently enhancing the evolving versions in a step-by-step manner until the complete system is built (Anwer, Aftab, Shah & Waheed, 2017). Each iteration incorporates design modifications and introduces additional functional capabilities. The fundamental concept underlying this approach is a to construct a system by employing iterative and incremental cycles. The development process commences by specifying and implementing a subset of the software, which is subsequently scrutinized to ascertain any supplementary requirements. Subsequently, this procedure is replicated, culminating in a fresh iteration of the software after each model iteration.

The iterative model, in contrast to the classic waterfall model, employs a cyclical process rather than a linear step-by-step approach to development stages (Ananda, Kuria & Ngigi, 2016). Once the initial planning step is finished, several stages are repeatedly carried out, with each completion of the cycle further enhancing and refining the program. Improvements can be promptly identified and incorporated into each iteration, ensuring that the subsequent iteration is at least slightly superior to the previous one.

The iterative design model is highly favoured by developers due to its efficiency, cost-effectiveness, and collaborative naure (Wang, Ge, Andreu, Xun, Jonathan, Klaus, Kyle, Chuang, 2022). This model allows developers to present results at each iteration stage, ensuring progressive alignment with client needs (Conforto & Amaral, 2016). Moreover, the iterative design model enhances usability, eliminates confusion, improves risk management, and facilitates continual improvement by incorporating lessons learned from previous iterations (Layton, Ostermiller & Kynaston, 2020). Notably, NASA and IBM adopted this model in the 1960s and 1970s for computer design, while Canada employed it in the 1990s for developing its air traffic control system (Buede & Miller, 2016).

Iterative design is now widely used in various industries, including engineering, design, marketing, and education. It involves a repetitive approach to product development and addressing market demands, as well as the creation of software applications. (Grudin, 2017). Software applications could range from proprietary software to end-user software, and shelf software designed to ensure that users maximize their experiences and also adequately use the software (Uzomba, Oluwatofunmi & Izuchukwu, 2015).

Software Requirement Analysis and Specification: The first step in every software development or product development is the requirement analysis and specification phase (Setti, Junior & Estorilio, 2021). This is the stage where the developer must ascertain the needs of the end-users or specify the problems to the addressed. The requirement analysis stage is not an assumption phase but a phase where requirements gathering is done. Requirement gathering involves regular interaction with the intending users and getting the user needs clearly defined. Ambiguity and complexities must be well explained and agree upon.

In this stage, the developer ensures that professional advice is given to the end user and best practices maintained. Costing and associated expenditures must not comprise standards or negate functionalities. The end users must be properly guided in making informed decisions and encouraged to drop irrelevant demands where necessary. In this phase, demands meet with advice and professional guidance. In this phase, no one is ignored and no question is irrelevant. The end-users state concerns and freely express their fear. The developer on the other hand must be receptive, simplistic, comforting, and very persuasive. The pros must be emphasized and the benefits clearly defined.

During this phase, the project's overall objectives and the expected challenges, opportunities, and instructions that initiated the project are determined. In this phase, teams must gather comprehensive and exact requirements in order to establish the essential timetable for software development. The procedure is carried out using the 'Software Requirement Specification document, also referred to as the 'SRS' document, which must undergo give feasibility checks; economic, legal, operational, technical, and scheduling feasibility (Dey, Chosh & Chakrabri, 2020).

Design Phase: The design phase is a pivotal and essential element in the software development life cycle. It entails, creating deign documents that are in accordance with the SRS document. This phase is crucial for developing the all-encompassing framework of the system and serves as input for the succeeding phases (Manimaran, Shammugam, Parimalam, Murali, & Murty, 2015). At this stage, two sorts of document are typically encountered: High-Level Design (HLD) and Low-Level Design (LLD). The High-Level Design (HLD) includes succinct explanations and labels for each module, a clear explanation of how each module functions, the interface connections and interdependencies between modules, the identification of database tables and their significant characteristics, and comprehensive architecture diagrams with accompanying technical specifications.

Conversely, the Low-Level Design (LLD) encompasses the operational logic of the modules, database tables with specifications about their kind and size, comprehensive information about the interface, resolution of all types of dependency problems, a compilation of error messages, and thorough documentation of the input and output for each module. Essentially, during this phase, software developers establish the specific technical aspects of the product, such as screen designs, databases, sketches, system interfaces, and prototypes. The client's approval of these specific is necessary before any development can commence, as they serve as a guide for the final product design choices and set expectations for the future product.

The design process encompasses several sub-phases, one of which is the UI design review. During this stage, visual representations of the future product are generated to refine its aesthetic aspects. Subsequently, technical design creation promptly ensures (Dahlman & Wesphal, 2019). The objective is to determine the implementation of the coding standards list, ensuring that project activities and estimated project deadlines are clearly articulated. The last step in the design phase involves the verification and confirmation of quality. Software developers here review and confirm that the design fulfils the client's requirements. A multitude of tests are conducted to identify issues such as bugs or design inconsistencies. Subsequently, the ultimate drawings are submitted to the project manager for authorization. Upon receiving approval from the manager, the team can proceed to the subsequent phase of development for the next prioject.

Development Phase: The development phase, sometimes referred to as the implementation phase, immediately follows the design phase. During this stage, software developers commence the construction of the full system by composing code using the designated programming language (Braude & Bermstein, 2016). During this stage, the tasks are partitioned into parts or modules and allocated to different developers (Stol and Fitzgerald, 2014). Developers are required to follow specified coding rules and use programming tools like compilers, interpreters, and debuggers to create and run the code. This phase represents the longest duration within the Software Development Life Cycle methodology. (Daleel, 2016)

The development phase involves the creation of the system, the integration and testing of the units into larger components, the establishment of a technological environment for the system, and receiving approval to move on to the testing phase (Boschert & Rosen, 2016). The primary goal of this phase is to convert the system design, which was prototyped in the Design Phase, into a fully operational information system that meets all the predetermined system requirements. Finally, the operating system enters the testing phase (Snders and Suppers, 2014).

Test Phase/Alpha Testing: The test phase, often known is the alpha testing phase, is the stage in software development where new software is examined to verify that it will function as anticipated (Hooda & Chhillar, 2015). Alpha testing is conducted in the early stages of development by internal personnel who posses a deep understanding of the of the end-user requirement. The intention of this testing is to verify that the software aligns with the original concept. This phase is conducted internally and includes thorough examination, identifying and fixing errors, the capacity to handle stress, and ensuring appropriate operation.

The alpha testing phase include assessing the inner workings of the technology and is also known as white box testing (Shikha & Bahi, 2015). The Alpha test participants often consist of engineers who passes the requisite expertise to provide developers with technical feedback and guidance on resolving any issues. During the initial round of alpha testing participants usually search for significant defects and weaknesses in features that could prevent the product from functioning as intended. Alpha testing may involve conducting load tests to verify that the product's functionality can be supported by the underlying code and physical architecture in different scenarios.

Review Phase/Beta Testing

Beta testing, also known as user testing, enables end users to validate the usability, functionality, compatibility, and reliability of a product (Leiecht, Blohm, & Leimeister, 2017). The Beta testing step of the software development life cycle allows the customer to provide feedback on the design, functionality, and usability of a product. The inputs are essential not just for the product's success but also as an investment in future products, assuring that the collected data is properly managed. The beta testing prerequisites include the costs related to testing, the number of test participants, the logistics of transportation, the duration of the test, and the level of demographic representation.

Beta testing is the last stage in the software development lifecyle (SDLC) before a product is launched. Its main purpose is to guarantee that end customers are content with a software product before it becomes widely available (GA) (Ramadan & Widyani, 2012). Beta testing integrates the risk of product failure by validating a with customers and enables engineers to assess the post-launch infrastructure. Additionally, it enhances product quality through client feedback, fosters positive customer sentiment, and boosts customer satisfaction. In order to commence beta testing, the document sign-off for Alpha testing must be provided, the beta version of the software should be prepared, the environment should be prepared for the release of the software application to the public, and a tool for capturing real-time defects should be available.

Schema

Figure 1

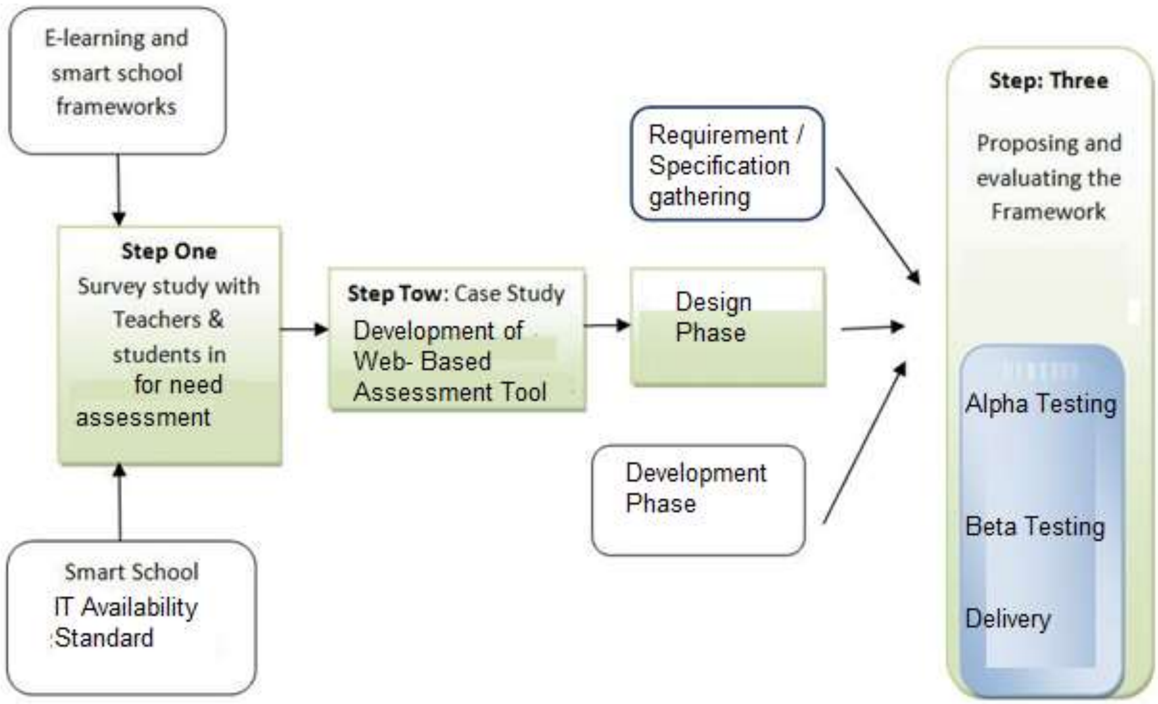


Figure 1: Illustration of the Schematic Diagram Showing the Process-flow for the Development of an Interactive Web Based Assessment Tool (IWBAT) Developed by the Researcher

Explanation of the Schema

The schematic diagram shows the process for the development of the Interactive Web Based Assessment Tool (IWBAT) which begins with the need assessment/ problem of the study. The survey study with teachers and students in the Enugu state smart schools under study shows that the schools have a major challenge with impersonation and other examination irregularities during the conduct of examination. This is due to the inability of the traditional examination screening process to completely identify and tab impersonators and other anomalies. The solution to the problem is the development of an Interactive Web Based Assessment Platform. The first step of the development begins with needs assessment where teachers and software architects are participants. The requirements from the needs assessment were used to design the IWBAT. The design includes the Algorithm design, schema, and the architectural design of the IWBAT. The design was used in the development phase and coding was done using PHP language. The next phase is the Test Phase/Alpha Testing in which the teachers and software architects are participants. When alpha testing was completed, the IWBAT was sent to the teachers and students for validation. The final validation is called the Review Phase/Beta Testing. The observations and corrections identified throughout the review phase were included to generate the ultimate iteration of the IWBAT.

Theoretical Framework

Professionals in the field of computers and information technology have formulated a number of theoretical frameworks to explain the development and adoption/ acceptance of Interactive web-based assessment platforms in schools. For the purpose of this study, the researcher will hinge the work on the Technology Acceptance Model, (TAM).

The Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed by Davis in 1989 to explain and understand factors affecting the development, acceptance and use of computer technology or ICT infrastructure in general in organizations/institutions (Davis, 1989). Basically, the Technology Acceptance Model (TAM) has been used by many researchers to explain and understand individual's acceptance and intention to use variety of information and communication technologies including the Interactive web-based assessment platforms (Eze, Obichukwu & Kesharwani 2021).

The TAM postulates that behavioral intention determines the actual adoption and use of information and communication technology viz a viz Interactive web-based assessment platforms. However, behavioral intention is jointly determined by two variables: perceived usefulness and perceived ease of use (Ghobahloo, Zulkiflu & Aziz 2010).

The perceived usefulness and perceived ease of use have helped in application of the TAM to explain and predict acceptance of the use of Interactive web-based assessment platforms by students in various disciplines. Perceived usefulness is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989: 320). This concept explains the expected overall effect of use of Interactive web-based assessment platforms on assessing academic performance of students. Davis (1989: 320) further theorized that “a system high in perceived usefulness is one for which the user believes in the existence of a positive use-performance relationship”. In other words, if a system (ICT) has a high degree of usefulness (productivity), it would be used by the potential user (students).

Consequently, from the concept of perceived usefulness, it is postulated that management of Enugu state smart school would readily access and use the Interactive web-based assessment platforms for the assessment of their students’ academic performance, if they believe that, this would definitely increase productivity and learning outcomes.

On the other hand, perceived ease of use is “the degree to which a person believes that using a particular system would be free from effort” (Davis, 1989: 320). So perceived ease of use deals with the situation in which little mental/physical effort is required in ICT usage in organization/institution by potential users. Hence, in the present study, perceived ease of use is defined as the degree to which management of smart schools and the students believes that accessing and utilizing Interactive web-based assessment platforms will be free from effort. Thus, to guide the study, using TAM, it is proposed that students who access and use the Interactive web-based assessment platforms are expected to be more productive than those who do not.

In sum, the TAM was found to be a solid theoretical model that "provides better understanding of user behaviour on the system and a multimedia acceptance model. Although, the TAM has been reported as the most widely used and robust theoretical model in Information Science in the study of acceptance and use of information and communication technology, observably it has its own limitations (Al-Shafi and Weerakkody 2009). According to this author, TAM has been found to exclude some important sources of variance and does not consider challenges such as time or money constraints as factors that would prevent an individual from using electronic resources.

Diffusion of Innovation Theory

The Diffusion of Innovation (DOT) Theory, developed by E.M. Rogers in 1962, is one of the oldest theories in the social sciences. This book explains the process via which an idea or innovation gains momentum and spreads across a certain group. The result of this process of dissemination is the assimilation of the novel concept or invention by individuals within a given social framework. Adoption involves individuals exhibiting behaviours that are distinct from their previous ones. The implementation of this innovation does not happen concurrently across a social structure. Instead, it is a progressive process in which select individuals have a greater inclination to adopt the innovation compared to others.

Research has shown that people who readily accept a new concept can be categorised into five distinct groups: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards. The adoption process is most challenging when it comes to laggards, who exhibit a strong attachment to tradition and a resistance to change. Therefore, strategies such as using fear appeals and leveraging the influence of individual in different adopter groups were utilised to accelerate the process of making decisions.

In order to achieve successful dissemination of an invention, there are five key characteristics that play a significant role. These factors are relative benefit, complexity, observability, which refers to the ability to try or experiment with the innovation before making a commitment to adopt it.

The IWBAT is expected to experience rapid adoption due to its ability to effectively detect and apprehend impersonators. This will likely lead to widespread acceptance among both early adopters and laggards. The early majority and late majority are also likely to embrace this innovation, as they recognise the system's robustness and inability to be compromised or bypassed. Consequently, the implementation of the IWBAT anticipated to enhance class attendance and eliminate instances of examination impersonation.

Review of Empirical Studies

Review of the related literature shows that some work had been done on effects of web-based learning in teaching and learning. However, there are some of the studies in other areas or field that are relevant to the study.

Gulsah and Muammer (2023) conducted a study on the effect of web-based biology learning environment on academic performance: A meta-analysis study. The major purpose of the study was to determine the effect of web-based biology leaning environment on academic performance: a meta-analysis study. Specifically, the study sought to determine how web-based biology learning environment influences students' academic performance; the moderator variables (e.g educational level and type of experimental design) positively affect students' academic performance regarding web-based biology learning environment. The study through a meta-analysis, examined the effect of web-based biology learning environment on students' academic performance. The study tried to explore practical significance of web-based biology learning environment by calculating effect-sizes of the experimental studies and adopted the quasi experimental design. The participants of the study consisted of 89 students, (51 in the experimental group and 38 in the contro1 group). There was no sampling carried out. A pre-test instrument prepared by the researchers was administered to each of the two groups at the beginning of the study; the researcher used web-based learning approach to teach the experimental group Biology and on the other hand, exposed the control group to the conventional (face-to-face) method in teaching the same Biology. At the end of the treatment, a post-test instrument which had been developed by the researchers was administered to each of the groups. Data obtained from the instruments descriptively using mean and Standard Deviation and inferentially using Analysis of Covariance (ANCOVA) with the aid of statistical package for social sciences (SPSS) version 15.0 computer software. The results showed that students in the experimental group performed better in post-test than pre-test. The effect-size difference between types of experimental design was found to be non-significant indicating that web-based biology learning environment is somewhat effective at improving students' academic.

The study is related to the present study in that both used web-based learning; also both studies were looking at improving students' academic performance. The difference in both studies is that while the present study focuses on web designing and development as a course, the previous study focuses on Biology.

The study conducted by Leonard, Alhaji, and Linus (2019) sought to examine the innovative approaches employed to address the issue of examination insecurity in public secondary schools within the Kogi East education zone in Kogi State. The objective of this study was to investigate the occurrence of examination insecurity in public secondary schools in the Kogi East education zone, and to analyse the solutions employed to address this issue within the same educational zone. The study employed a descriptive survey approach and was guided by two research inquiries. Nigeria has a total of 208 secondary schools, in addition to other organisations that oversee the administration of examinations. The organisations mentioned include the Ministry of Education Council (MOE), the West African Examination Council (WEAC), the National Examination Council (NECO), the Teaching Service Commission (TSC), and the Science Teachers' Education Board (STEB). The combined workforce of these institutions amounts to 25,010 employees. The study utilised a sample size of 250 people, which constituted 10% of the total population. The study employed the Examination Insecurity Assessment Barometer (EIAB) as the primary instrument, while mean and standard deviation were utilised to address the research inquiries. The study findings indicated that examination insecurity in public secondary schools in the Kogi East education zone mostly expressed through the prevalence of leakage, script flipping, smuggling of response scripts into examination halls, and impersonation. Furthermore, it is important to contemplate the use of biometric data gathering in all public examinations and the utilisation of online test writing as a replacement for traditional manual procedures. This study is comparable to the present study because it tries to tackle issues faced in administering exams by using innovations and technology. Nevertheless, there exists a significant disparity between the two research. While the previous study mainly concentrates on suggesting theoretical answers, the present study has gone a step further by creating the IWBAT using server-side scripting technology.

Adekunle, Jimoh & Adegbenro (2018) conducted a study on effects of web-based instruction on students' attitudes, self-efficacy, anxiety and academic achievement in general metalwork in Technical colleges. The major purpose of the study was to determine the effects of web-based instruction on students' attitudes, self-efficacy, anxiety and academic achievement in general metalwork in Technical colleges. Specifically, the study sought to determine the effect of web-based instruction on mechanical trade students, academic achievement in general metal work; the difference between the pre-test and post-test mean scores of mechanical trade students' attitude when taught general metal work using the web-based instruction; the difference between the pre-test and post-test mean scores of mechanical trade students' self-efficacy when taught general metal work using the web-based instruction; the difference between the pre-test and post-test mean scores of mechanical trade students' anxiety when taught general metal work using the web-based instruction. Quasi-experimental research design was used for the study; specifically, the non-equivalent pre-test post-test control group design. The design was considered most appropriate because students in their intact classes participated in the study. The population of the study comprised of all 105 National Technical Certificate (NTC) II mechanical trade students from three technical colleges of 2015/2016 session. The instruments used for data collection were Mechanical Trade Achievement Test (MTAT) and Students' Attitude, Self-Efficacy and Anxiety Scale (SASA). MTAT consisted of 20 multiple choice items with four options A-D, while SASA consisted of 35items and divided into three sections A- C. The instruments were pilot tested on 20 students from Government Technical College, Ogbomoso. Using Kuder Richardson, the reliability coefficient of MTAT yielded 0.87, while the internal consistency of SASA was estimated using Cronbach Alfa reliability test and it yielded 0.83, 0.90 and 0.77 for sections A,B and C respectively. MTAT and SASA were administered on the experimental group, while MTAT alone was administered on the control group. The experiment lasted for six weeks with the same units taught to the two groups. At the end of the teaching and treatment, a post-test was carried out after the pre-test. The data collected were analyzed using mean and standard deviation to answer research questions while t-test and ANCOVA were used to test the hypotheses. Data obtained from the study showed that students taught using WBI had higher post-test mean than those taught in conventional class. Based on the findings of the study, it was established that web-based instruction approach for students' academic achievement, self-efficacy, anxiety and attitudes towards the use of technology for learning general metal work in technical college was effective. The study is related to the present study in that both studies uses web-based approach.

Asogwa (2018) conducted a study on the effect of flipped learning on students' academic achievement in QBASIC programming language in colleges of education. The major purpose of the study was to determine the effect of flipped learning on students' academic achievement in QBASIC programming language. Specifically, the study sought to determine the students' academic achievement mean gain in QBASIC programming language when taught with flipped learning approach; the students' academic achievement mean gain in QBASIC programming language when taught with flipped learning approach and when taught without flipped learning approach; the influence of gender on the students' academic achievement mean gain in QBASIC programming language when taught with flipped learning approach; the interest level of students in learning QBASIC programming language using flipped learning approach. The study adopted the quasi experimental (pre-test/post-test control group) design. The participants of the study consisted of 108 students, (67 in the experimental group and 41 in the control group). There was no sampling carried out. A pre-test instrument prepared by the researcher was administered to each of the two groups at the beginning of the study; the researcher used flipped earning approach to teach the experimental group QBASIC programming language and on the other hand, exposed the control group to the conventional (face-to-face) method in teaching the same QBASIC programming language. At the end of the treatment, a post-test instrument which had been developed by the researcher was administered to each of the groups. Data obtained from the instruments descriptively using mean and Standard Deviation and inferentially using analysis of Covariance (ANCOVA) with the aid of statistical package for social sciences (SPSS) version 20 computer software. The results showed that students in the experimental group performed better in post-test than pre-test (p=0.00) indicating an improvement on students' achievement gain in QBASIC programming language when taught using flipped learning approach. Similarly, the results showed that students in the experimental group had better performance compared to those in the control group (p=0.00) indicating that flipped learning approach is more effective. Also, the results showed that use of flipped learning approach based on gender brought about achievement gain of QBASIC programming for male students compared to female students ($p=0.947$). Finally, the study revealed a high interest level of students in learning QBASIC programming language using flipped learning approach with grand mean score of 3.48 and standard deviation of 0.17.

The study is related to the present study in that both are using the same research design to determine the effect of a teaching approach on students' academic achievement. The difference is that while te present study is looking at the effect of web-based learning, the previous study looked at the effect of flipped learning. Also, while the present study concentrates on web designing and development, the previous study focuses on QBASIC programming language.

Chilaka (2017) carried out a study to determine the strategies for improving students' academic achievements in Visual Basic programming language in Colleges of Education in Enugu State. The study adopted survey research design. Four research questions guided the study. The population of the study consisted of 57 respondents comprising 32 lecturers and 25instructors of computer Education from five selected colleges of Education in Enugu state. Structured Questionnaire was designed and used for data collection. Data was analyzed using mean, standard deviation and t-test statistics. SPSS 15.0 was used to check accuracy of the analysis. A reliability coefficient of 0.92 was obtained using Cronbach Alpha. The findings of the study revealed that respondents agreed that the suggested strategies be employed to improve students' academic achievements in Visual Basic programming language.

The present study is related to the previous study in that both studies are interested in the academic achievement of students. The difference in both studies is that while the previous study is interested in using different strategies to improve students' academic achievement in Visual Basic programming language, the present study is interested in specifically using web-based learning approach to improve student's academic achievement in web designing and development.

Onaolamipo (2014) did a study on the creation of a Computerized Biometric Control system for screening and tracking attendance during examinations, along with managing fees. The purpose of the study was to develop a system that can take student class attendance screen students before and after examination and verify students' registration status. The system implemented authentication access control methods and was developed with an expanded graphical user interface applying with an editor VSCode. The student information was saved in MySQL database, which functions as a database system situated on the user's computer or server. Finding shows that the system is consistent, secured, efficient, flexible and has a high level of integrity in registration and data management. A correlation appears in the study due to it aims at curbing examination impersonation using a unimodal biometric system but there exists a gap because the present study uses server-side scripting technology, a Web-Based Assessment Tool (WBAT) and it is only interested in the admittance and moderation of students for an examination and not involved in fee payment or management.

Amirthalingam and Gandhimahi (2014) conducted a study on a multimodal approach for a Face and Ear Biometric System. The primary objective of the study is to examine and evaluate the key works in Web-Based Assessment Tool (WBAT) and their effectiveness in detecting and recognizing individuals. The findings of the study having compared various multimodal fusion techniques established that the multimodal fusion outweights the unimodal. The study shows that using facial recognition significantly enhances the accuracy of detection and recognition. A relationship exists with the present study as both focus on a Web-Based Assessment Tool (WBAT); however, a gap remains since the previous study mainly reviewed the benefits of WBAT using facial recognition. In contrast, the present study develops a Web-Based Assessment Tool (WBAT) using Hypertext Pre-processor (PHP), integrating facial recognition to help curb examination impersonation.

Gathuri, Luvanda, Matende, and Kamundi (2014) examined the difficulties related to impersonation that arise during the electronic assessment of university students. The project aimed to analyse the challenges associated with verifying online assessments, assess the benefits and drawbacks of existing authentication systems, and investigate novel approaches. The sample size was determined from a group of E-learning University students who are now studying in the Faculty of Vocational and Technical Education at University of Nigeria, Nsukka. The authentication of students during online examinations was performed using the profile-based authentication framework (PBAF), which combines the user's identification and password with a challenge question selected from their profile. This method was tested and verified in a virtual learning environment. The findings indicated that the PBAF e-assessment was more secure in terms of the authentication process. This study has relationship with the present study as they both seek to tackle cases of examination impersonation but there exists a gap because the present study uses an facial recognition system in curbing cases of examination impersonation.

Summary of Reviewed Literature

The literature reviewed for this study shows that the use of web-based assessment platform is a supplement to traditional method of assessment. The studied literature encompassed a conceptual framework comprising the smart school concepts, assessment, examination system in Nigeria, the software development lifecycle, and an iterative design approach. The theories that were examined include Technology Acceptance Model by Davis and the Theory of Diffusion of Innovation by Rogers. The technology acceptance model explains the factors affecting the acceptance and use of computer technology or ICT infrastructure in general in organizations/institutions and posits that behavioral intention which is jointly determined by two variables – perceived usefulness and perceived ease of use, determines the actual use of information and communication technology. The implication of this study suggests that a system high in perceived usefulness is one for which the user believes in the existence of a positive use-performance relationship. On the other hand, perceived ease of use defines the degree to which students believes that accessing and utilizing electronic information resources will be free from effort by effectively monitoring external conditions and behaviours. However, with these two variables, the innovation will eventually be fully embraced. The DOI Model promotes the process via which an idea or innovation gains momentum and spreads across a certain group by ensuring that technology is enhancing, or revolutionizing the current solution. The ideologies derived from the examined theories were embraced due to the empirical studies that uncovered relevant findings pertaining to the subject matter.

However, the researcher is not aware of any existing work on the creation of an Interactive Web-Based Assessment Tool as a proposed innovation for the Enugu State Smart schools. Hence, this study addresses a gap by concentrating on the development of an Interactive Web-Based Assessment Tool using R & D development methodology.

CHAPTER THREE

METHODOLOGY

This chapter outlines the methodology that will be employed in conducting this study and is organized into the following sections: design of the study, area of the study, population for the study, sample ad sampling techniques, instruments for data collection, validation of instruments, Developmental procedure, method of data collection, and method of data analysis.

Design of the Study

This study utilized the R&D (Research and Development) design. According to Gustiani (2019), Research and Development (R&D) design by Gall, Gall and Borg is the investigational activities conducted to improve existing products and procedures or to contribute to the development of new products or procedures. This study considered the R&D design as suitable because it intended to develop an interactive web-based assessment tool (IWBAT) for integration in the smart basic schools to assess students learning outcomes. The cycle of research and development consists of ten stages that can be repeated until the product meets the specified standards. The ten steps are:

1. Research and Information Collection
2. Planning
3. Prototype Development
4. Preliminary field testing
5. Main product revision
6. Main field testing
7. Operational Product Revision
8. Operational Field Testing
9. Final Product Revision

10. Dissemination and implementation

R&D Step 1 is used to collect research data using the iteration model. R&D step 2 involved the design of IWBAT, while R&D step 3 focused on the development of IWBAT. R&D step 4 was dedicated to the test phase, and R&D step 5 – 10 encompasses the review phase of IWBAT. However, this study will employ Royce's 1970 theoretical foundation of the iterative life cycle model to guide the development of IWBAT (Royce 2021). These foundations consist of five distinct phases: Requirement gathering, design, prototype development, test phase, and review phase. This study aims to integrate the steps of Research and Development (R&D) with the iterative life cycle model to establish the phases for the current research endeavor. This is in line with the assertions of Larson and Lockee (2019) who stated that researchers are at liberty to streamline superfluous procedures in Research and Development (R&D) and adapt the stages involved to effectively accomplish the study objectives. Armed with this, the study is guided by the following five distinct phases.

Phase I: Software requirement gathering of IWBAT: this is the phase where the requirement or specification of the IWBAT will be collected. Here the stakeholders and experts will be engaged to ascertain the requirement for the IWBAT.

Phase II: Architectural design/ blueprint of the IWBAT: this phase will handle the blueprint of the IWBAT. It will ensure that use case exist and that the picture of the experts is clear on paper before moving to phase III

Phase III: Development of IWBAT: this phase will involve the development of the IWBAT based on the architectural design.

Phase IV: Alpha Testing phase of the IWBAT: this phase will involve the in-house testing of the developed IWBAT by experts (teachers, software experts and stakeholders) to ascertain the functionality of the IWBAT according to the requirement that guided the development.

Phase V: Beta Testing phase of IWBAT: this phase involves the users assessing the system to ascertain that it meets the requirements that guided its development.

Area of the Study

The study will be conducted in Enugu State smart schools. Enugu state is one of the 36 states in Nigeria and is made up of 17 local government areas. Enugu state is currently on a smart school project across her 260 political wards. The choice of this area of the study is due to the increasing dearth of ICT infrastructure to support the smart schools especially in the area of web-based assessment. Furthermore, is the availability of the smart schools which will facilitate data collection and testing of the IWBAT.

Population for the study

The population of this study is 169 comprising of 2 software architects from ICT department of University of Nigeria, Nsukka. 17 teachers who are ICT experts that will use the software to assess the students and 150 students drawn from two smarts schools that are ready during the time of conducting this study. The population distribution is as shown in **Appendix A** (page 89)

Phase I: The population for the study at Phase (I) is 19 which will form the population for the software requirement analysis. This comprises the 17 teachers who are ICT experts drawn from the two smart schools under study, and 2 software architects from ICT department of the University of Nigeria, Nsukka.

Part II: The population for the study at this phase is 19. This comprise 17 teachers who are ICT experts drawn from the two schools under study and 2 software architects from ICT department of the University of Nigeria, Nsukka who will be used to check the extent to which the architectural design is appropriate for the development of the IWBAT software. Software architects will be used in this phase because they are professionals who used tools and methodologies to create representations for functions and user interface of a desired product.

Phase III: the population for the study at this phase is 19. This comprise 17 teachers who are ICT experts drawn from the two schools under study and 2 software architects from ICT department of the University of Nigeria, Nsukka who will be used to check the extent to which the architectural blueprint/design for the development of the IWBAT software conform to the software requirement specification. Software architects will be used in this phase because they are professionals who used tools and methodologies to create representations for functions and user interface of a desired product.

Phase IV: the population for the study at this phase is 19 and this will form the population for the test phase/Alpha testing of the IWBAT. This will comprise 17 teachers who are ICT experts drawn from the two schools under study and 2 software architects from ICT department of the University of Nigeria. Software architects and the ICT experts from the government education board will be used for the test phase/Alpha testing of the IWBAT because they are the experts and will ascertain the functionality of the IWBAT.

Phase V: the population for the study at this phase is 169. This will comprise 17 teachers who are ICT experts drawn from the two schools under study, the 2 software architects from ICT department of the University of Nigeria, and the 150 students drawn from the two smart schools in Enugu state that have been completed and is already operational. The teachers and students will be used for this review phase /

Beta testing because they are qualified to make professional decisions being the end users. The students will ascertain the functionality of the IWBAT and the ease in admitting students for examination using the IWBAT.

Sample and Sampling Techniques

The sample size of the study is 169. This will comprise 17 teachers who are ICT experts drawn from the two schools under study, the 2 software architects from ICT department of the University of Nigeria, and the 150 students drawn from the two smart schools in Enugu state that have been completed and is already operational. Total sampling technique will be used in phase V to select the entire students at the two smart schools. Total sampling technique is a type of sampling technique where the whole population of interest is studied (Stephanie, 2018). The technique will be used to select the entire 150 students drawn from the two smart schools in Enugu state that have been completed and is already operational as prescribed by Afolabi (1993), who stated that the entire sample size from a population is enough to ensure representation of the population that ranges from 1000 (one thousands) and above and manageable. It is most practical when 150 students' population is of manageable size. Hence, it is suitable for this study. See sample distribution in **Appendix B** (pages 90-91).

Phase I: The sample size at Phase (I) is 19. This comprises the 17 teachers who are ICT experts drawn from the two schools under study, and 2 software architects from ICT department of the University of Nigeria, Nsukka to ascertain the requirements for the IWBAT. The rationale for this was supported by Cresswell (2012) who asserted that to learn or understand the essential phenomenon, a researcher selects individuals and sites intentionally.

Part II: The sample size at this phase is 19. This comprise 17 teachers who are ICT experts drawn from the two schools under study and 2 software architects from ICT department of the University of Nigeria, Nsukka who will be used to check the extent to which the architectural design is appropriate for the development of the IWBAT software. The total software architects will be used in this phase because the size is manageable.

Phase III: the sample size at this phase is 19. This comprise 17 teachers who are ICT experts drawn from the two schools under study and 2 software architects from ICT department of the University of Nigeria, Nsukka who will be used to check the extent to which the architectural blueprint/design for the development of the IWBAT software conform to the software requirement specification. Total population of the software architects will be used in this phase because of the manageable size.

Phase IV: the sample size at this phase is 19 and this will form the population for the test phase/Alpha testing of the IWBAT. This will comprise 17 teachers who are ICT experts drawn from the two schools under study and 2 software architects from ICT department of the University of Nigeria. total population of software architects and the ICT experts from the government education board will be used for the test phase/Alpha testing of the IWBAT to ascertain the functionality of the IWBAT.

Phase V: the sample size at this phase is 169. This will comprise 17 teachers who are ICT experts drawn from the two schools under study, the 2 software architects from ICT department of the University of Nigeria, and the 150 students drawn from the two smart schools in Enugu state that have been completed and is already operational. The teachers and students will be used for this review phase / Beta testing to ensure that the IWBAT will meet the end user needs.

Instrument for Data Collection

Two instruments will be used for data collection. These are Interactive Web-Based Assessment Expert Questionnaire (IWBAEQ) and Interactive Web-Based Assessment User Questionnaire developed by the researcher.

In Phase I –IV, IWBAEQ will be used to elicit information from the government stakeholders who are ICT experts and software architect from the ICT department of the University of Nigeria, Nsukka on the software requirements for the development of the IWBAT and it is divided into two parts. Part one obtained information on the personal data of the respondents while part two obtained information that will aid the development of IWBAT. Part two is divided into three (3) sections. Section A elicited information on the software requirement of the IWBAT (7 items). It has four response pattern of Highly Required (4 points), Required (3 points), Slightly Required (2 points) and Not Required (1 point). Section B elicited responses on the appropriateness of the architectural design of the IWBAT (5 items). It has four response pattern of Highly Appropriate (4 points), Appropriate (3 points), Moderately Appropriate (2 points) and Not Appropriate (1 point). Section C elicited information on the extent of conformity of the IWBAT to architectural design (8 items). It has four response pattern of Excellent (4 points), Good (3 points), Fair (2 points) and Poor (1 point). Section D elicited information on the functionality of the IWBAT (7 items) and also has four response pattern of Excellent (4 points), Good (3 points), Fair (2 points) and Poor (1 point).

In phase V, interactive web-based assessment User Questionnaire (IWBAUQ) will be used to access user reviews of the IWBAT. Section A will elicit information on the user review of the IWBAT (5 items). IWBAUQ will ascertain any challenge encountered, capture ease of use and collate the needed improvements. IWBAUQ is structured on a four-point response option of Excellent (4 points), Good (3 points), Fair (2 points) and Poor (1 point).

Validation of the Instrument

The two questionnaires will be face validated by three experts from the department of computer and Robotics Education, University of Nigeria, Nsukka and two software developer from Tenece

Professional Services Ltd, Enugu. The experts will be asked to check if the suitability of the User Questionnaire to measure / check the usability of the IWBAT.

Reliability of the Instrument

The assessment of internal consistency for the instruments will be conducted utilizing Crombach alpha. This approach is chosen due to its capacity to evaluate the internal consistency and reliability of the survey items. The reliability of the Expert Questionnaire and the User Questionnaire will be assessed through a trial testing process that will involve 10 lecturers from the University of Nigeria which is outside the scope of the present study. However, the choice of University of Nigeria which does not have similar characteristics is in-line with the study of who stated that if it is not possible to find an institution with identical characteristics, it is essential to pilot test the instrument in multiple context. This can help identify potential issues and improve the instrument's reliability across different settings.

Development / Experimental Procedures

The Interactive Web-Based Assessment Tool (IWBAT) will be developed through the following processes

- Collection of all the necessary materials needed for development
- Drawing of program flowchart for the development of IWBAT
- Installation of all needed software application and libraries on host
- Design of Graphics User Interface (GUI) using simple HTML, CSS and JavaScript
- Interfacing the GUI with the server end
- Deployment on live server (Internet)
- Testing (Unit Testing and System Testing)

- Final release of the IWBAT

Method of Data Collection

In phase I – III the Interactive Web-Based Assessment Expert Questionnaire (IWBAEQ) will be administered by the researcher to identify the specification used in developing the IWBAT. This expert Questionnaire to be administered will involve gathering information on the structure of the IWBAT, architectural design for the developing of the IWBAT, and compatibility issues. The specification will be collected and used in the development of the IWBAT.

In phase IV – V the Interactive Web-Based Assessment User Questionnaire (IWBAUQ) will be administered to the 169 respondents by the research assistants and collected immediately. The experts will ascertain the functionality of the IWBAT while teachers and students will review the usage of the IWBAT. Data collected from the respondents will be used to improve the design of the IWBAT towards making a quality development that will ensure standard assessment of the students.

Method of Data Analysis

The data generated for this study will be analyzed using the Statistical Package for the Social Sciences (SPSS). Research Question 1 will be analyzed using mean and standard deviation. The decision rule for research question 1 will be based on the cut-off point of 2.50 on a 4-point scale for items that are required. Responses on research questions 2, 3, 4 and 5 will be judged based on real limits of numbers of Highly Appropriate / Excellent (3.50 – 4.00), Appropriate / Good (2.50 – 3.49), Moderately Appropriate / Fair (1.50 – 2.49) and Not Appropriate / Poor (0.5 – 1.49). the standard deviation will check how divergent or close the responses are to the mean.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter presents the results from data analysis, findings and discussion of findings for the study, Presentation were organized according to the research questions that guided the study.

Research question 1: What are the software requirement specifications for the Interactive Web-Based Assessment Tool (IWBAT)?

The data collected for this research question is presented in Table 1 based on software requirements specifications for the development of the Interactive Web-Based Assessment Tool (IWBAT)?

Table 1: Mean responses on the Software Requirement Specifications for the development of the Interactive Web-Based Assessment Tool (IWBAT).

N=39

S/No	Items	X	SD	Remarks
1	Web-based Assessment Software	3.98	0.16	Required
2	64 Bit Operating System	3.75	0.44	Required
3	32 Bit operating System	3.58	0.47	Required
4	PHP Software	3.69	0.47	Required
5	Database for creating User account	3.83	0.39	Required
	Overall mean	**3.67**	**0.46**	**Required**

Table 1 showed the result of the software requirement specification analysis of the Interactive Web-Based Assessment Tool (IWBAT). All the items (1-5) had mean scores ranged from 3.58 which are above the cut-off point of 2.50 indicating that the items are required specifications for the development of the Interactive Web-Based Assessment Tool (IWBAT). The standard deviation score ranged from 0.16-0.72 indicating that the responses are not divergent.

Research question 2: To what extent is the architectural design appropriate for the development of the Interactive Web-Based Assessment Tool (IWBAT)?

Table 2 showed the result of the extent the architectural design is appropriate for the developed Interactive Web-Based Assessment Tool (IWBAT). all the items (1-5) had mean scores ranged from 3.65-3.80 indicating that the items are highly appropriate for the developed IWBAT

Table 2: Mean responses on rating how appropriate are the architectural design of the developed IWBAT. N=39

S/No	Items	X	SD	Remarks
1	Architectural flow diagram of the IWBAT	3.80	0.46	Highly Appropriate
2	User Interface Design of the IWBAT	3.60	0.44	Highly Appropriate
3	USE Case View of the IWBAT	3.80	0.46	Highly Appropriate
4	Technical design of the IWBAT	3.65	0.46	Highly Appropriate
5	Quality verification and validation	3.70	.46	Highly Appropriate
	Overall Mean	**3.71**	**0.46**	Highly Appropriate

Table 2 showed the result of the extent the architectural design is appropriate for the developed Interactive Web-Based Assessment Tool (IWBAT). All the items (1-5) had mean scores ranged from 3.65 – 3.80 indicating that the items are highly appropriate, and the architectural design is highly appropriate for the development of the IWBAT. the standard deviation score ranged from 0.44-0.46 indicating that the responses are not divergent.

Research question 3: To what extent does the developed Interactive Web-Based Assessment Tool (IWBAT) conform to the architectural design that guided the development?

The data collected for research questions 3 was presented in Table 3 based on the extent of conformity of the IWBAT to architectural design.

Table 3: Mean responses on rating the extent of conformity of the developed IWBAT to architectural design

S/No	Items	X	SD	Remarks
1	Facial Recognition	3.95	0.22	Excellent
2	Student Identification	3.70	0.46	Excellent
3	Identification of impersonators	3.63	0.54	Excellent
4	Fast Processing of Data	3.78	0.42	Excellent
5	Highly secure system	3.80	0.41	Excellent
6	Accommodates large classes	3.78	0.42	Excellent
7	Stable over a long time.	3.70	0.52	Excellent
	Overall Mean	**3.75**	**0.43**	**Excellent**

Table 3 shows the result of the extent of conformity of the developed IWBAT to architectural design. The lecturers and software architects rated all items (1-7) as excellent with mean scores ranging from 3.63 – 3.95 which implies that the developed IWBAT conforms excellently to the architectural design that guided its development. The standard deviation score ranged from 0.4-0.52 indicating that the responses are not divergent.

Research question 4: To what extent does the functionality of the Interactive Web-Based Assessment Tool (IWBAT) conform to the requirements that guided its design (Alpha Testing)?

The data collected for answering research question 4 is as shown on Table 4.

Table 4: Mean responses on the functionality of the Interactive Web-Based Assessment Tool (IWBAT)

S/No	Items	X	SD	Remarks
1	Compatible with different operating systems	3.64	0.51	Excellent
2	Quick Processing Time	3.57	0.44	Excellent

3	Prompt student enrolment	3.51	0,57	Excellent
4	Prompt facial upload	3.50	0.53	Excellent
5	Prompt facial verification	3.50	0.60	Excellent
	Overall Mean	**3.54**	**.56**	Excellent

Table 4 showed the result of the functionality of the developed Interactive Web-based Assessment Tool (IWBAT). The lecturers and students rated all items (1-5) as excellent with mean scores ranged from 3.50 – 3.64 indicating that the functionality of the developed IWBAT conforms excellently to the requirements that guided its design (Alpha Testing). The standard deviation score ranged from 0.53-0.60 indicating that the responses are not divergent.

Research question 5: To what extent does user review of the Interactive Web-based Assessment Tool (IWBAT) developed conform to the requirements that guided its design (Beta Testing)?

The data collected for answering research question 5 is as shown on table 5.

Table 5: Mean responses on user review of the Interactive Web-Based Assessment Tool (IWBAT).

N=2.35

S/No	**Items**	**X**	**SD**	**Remarks**
1	Ease of use.	3.62	0.52	Excellent
2	Effectively identifies impersonator	3.42	0.58	Excellent
3	Highly secured system	3.43	0.61	Excellent
4	Fast processing and verification of students	3.37	0.61	Excellent
5	Withstand stress testing	3.25	0.70	Excellent
	Overall Mean	**3.45**	**0.62**	Excellent

Table 5 showed the result of the user review by lecturers and students of the developed Interactive Web-Based Assessment Tool (IWBAT). The table revealed that all the items (1-5) considered for the user review with mean scores ranged from 3.25 to 3.62 re rated as excellent indicating that the user review of the IWBAT conforms excellently to the requirements that guided its design (Beta Testing).

Findings of the Study

The following findings emerged from the study based on the research questions.

Findings from research question 1 showed that the development for the Interactive Web-Based Assessment Tool (IWBAT) requires the following specifications:

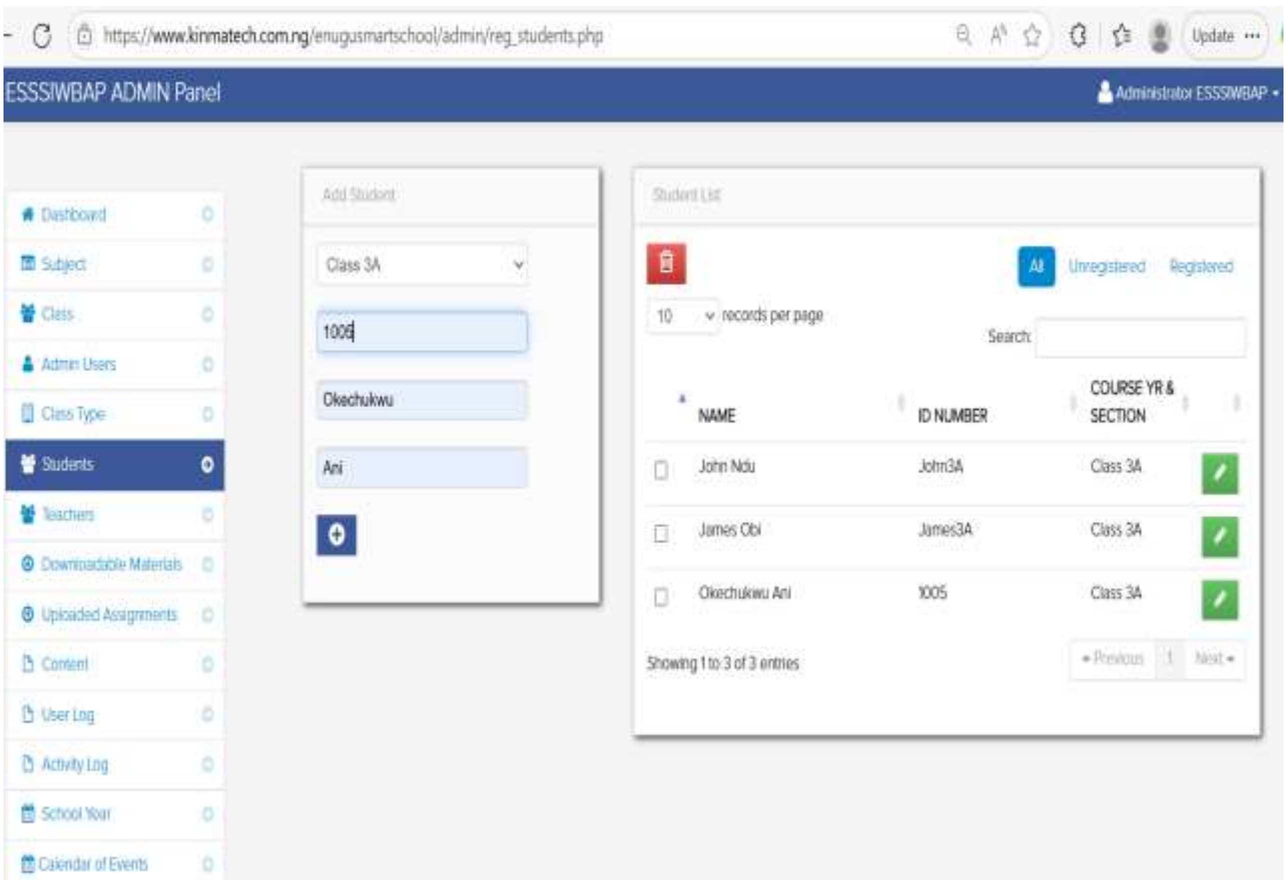
a. Web-based Assessment software.
b. 64-bit system compatibility
c. 32-bit system compatibility.
d. PHP software compatibility
e. Database software for creating user accounts.

1. The architectural design was done after the software requirement specification phase and was appropriate for the study and fit for the development of the Interactive Web-Based Assessment Tool (IWBAT).
2. Finding from research question two showed that the following are highly appropriate for the architectural design of the developed Interactive Web-Based Assessment Tool (IWBAT) as following:

a. The Architectural flow diagram.
b. The User Interface Design.
c. The Use Case View.
d. The Technical design
e. The quality verification and validation.

3. Findings from the developed MFBS showed that the hardware components and the software components worked excellently, and the system was completed according to the architectural design, circuit diagram and the user interface design.
4. Findings from the developed IWBAT showed that the login page captured all the necessary information needed from the student for enrolment.

FIGURE 2: Enrolment Page of IWBAT



Student Enrollment Page by Admin

5. Finding form the developed IWBAT showed that the facial upload and saving was done seamlessly.

FIGURE 3: Uploading the Facial Image of the Student

Student Signup Page after being enrolled by the admin

6. Finding from the developed IWBAT showed that the IWBAT during login checked for both the user credentials and facial image.

IMAGE OF THE STUDENTS

7. Findings from the developed IWBAT showed that the developed IWBAT captured attendance of verified students.
8. Findings from research 3 showed that the developed Interactive Web-Based Assessment Tool (IWBAT) was rated excellent for the following

a. Facial recognition.

b. Identification of students for examinations.

c. Identification of impersonators.

d. Fast processing of data.

e. High security of system.

f. Ability to accommodate large classes.

g. The stability of the system over a longer period of time.

9. Findings from research question 4 showed the extent to which the functionality of the developed Interactive Web-Based Assessment Tool (IWBAT) conform to specifications that guided its design in the alpha testing phase. The developed Interactive Web-Based Assessment Tool (IWBAT) was rated excellent for the following:

a. Compatibility with different operating systems.

b. Quickly processing of students.

c. Prompt enrolment of students

d. Prompt uploading of facial details during enrolment

e. Prompt verification of faces during examinations.

10. Findings from research question 5 showed the extent to which users rate the conformity of the developed Interactive Web-based Assessment Tool (IWBAT) to specifications that guided its design in the beta testing phase. The users rated the developed FBTS as excellent for the following:

a. Ease of use

b. Effectiveness in identifying impersonators

c. High security of the system

d. Fast processing and verifying students.

e. Ability to withstand stress testing.

Discussion of the Findings

The findings on the specifications that guided the design of the Interactive Web-Based Assessment Tool (IWBAT) revealed that the web-based Assessment software and the PHP server-side scripting software are highly required for the development of the IWBAT, and this agrees with the recommendation of Peng, Portugal, Alencar & Cowan (2021) on the assessment as a necessity for improved examination system. The assessment software must be compatible with different operating system for it to function maximally as the software drives the hardware device. Furthermore, the IWBAT can be installed on a 64-bit and 32-bit system without malfunctioning. This aligns with the assertion by Wressengger, Yamaguchi, Maiex & Rieck, (2016) for software solutions to be compatible with both 64-bit and 32-bit computer systems. The PHP software and the database software of the Interactive Web-Based Assessment Tool (IWBAT) are also required for the smooth running of the IWBAT.

The findings on the extent of appropriateness of the architectural design for the development of the IWBAT revealed that the user interface design is excellent and needs the required standard. The technical design and quality verification and validation also met the requirements set for the developed IWBAT. architectural flow diagram, User Interface Design, Use Case View, Technical design and Quality verification and validation are features that must be considered in a system when architectural design is been checked. This agrees with the assertion by (Bialy, Pantellic, Jaskolka, Schaap, Patcas, Lawford, & Wassyng, 2027) that the design phase is when the architectural design developed to meet the software requirement specification (SRS). Architectural design encompasses the depiction of constituent elements that form system, the interplay between these elements, the guidelines governing their arrangement and the regulations governing these guidelines. Di Martino & Exposito (2016) further said that the architectural design defines the plan for a solution which includes algorithm design, software architecture design, schema and logical diagram design and the Unified Modelling Language (UML).

The findings in the development of the IWBAT showed that the materials listed for the development of the IWBAT were sufficient for the development and the relevant software were compatible on Windows and Linux operating systems. The IWBAT was free of bugs. The web component was very responsive and compatible on various browser types. The system is ready for full deployment.

The findings on the conformity of the IWBAT to the architectural design revealed that the developed IWBAT could upload facial feature and use same in the easy detection of students and impersonators. This conforms to the architectural design as the developed IWBAT could capture multimodal features of students during enrolment and provide an interface for accessing the student details and information. This aligns with the assertion made by Sanders & Stappers (2014) that the main objective of the development phase is to transform the system design, which was prototyped in the Design Phase, into a functional system that fulfils the entire recorded system requirement.

The findings on the functionality test conducted on the Interactive Web-Based Assessment Tool (IWBAT) revealed that the IWBAT functional in line with defined requirements. The various features of the developed IWBAT, such as compatibility with different operating systems, fast student processing prompt student enrolment, efficient facial detail upload during enrolment, and quick face verification during examinations, were all rated as excellent. Hooda and Chihillar (2015) state that the alpha testing phase is the stage of software validation where new software is tested to guarantee that it will function as anticipated. Sallis (2014) further asserted that, assessing a developed program ensures that the work products and procedures meet predetermined provisions and plans. It also instils confidence that the software corresponds to specified technical specifications.

The findings on the user testing conducted on the Interactive Web-Based Assessment Tool (IWBAT) revealed that all items such as ease of use, effectively identifying impersonators, highly secured system, fast processing, and verification of students and the IWBAT ability to withstand stress feasting were excellent. This agrees with the assertion by Aguboshim & Miles (2018) that ease of use is a major consideration in the development of any new system. The system should be easy to use for the people it is designed for. The evaluation of Lecturers and students throughout the beta testing demonstrated that the IWBAT adheres to its intended design and can successfully accomplish its designated aim.

CHAPTER FIVE

SUMMARY AND CONCLUSION

This chapter presents the summary of statement of the problem, procedures used and the major findings. Also presented in this chapter includes conclusion based on the findings, the implication of the findings, recommendations for implementation and suggestion for further research.

Problem and Objective of the Study

Students have devised ways to get around the checking system, either by avoiding it directly or with the help of dishonest staff who benefit from the practice. Exam impersonation has become a major problem in educational institutions, negatively impacting learning outcomes and accomplishments. By avoiding several manual processes, such physically identifying examinees and using class entrance cards, which were previously put in place to guarantee the effective administration of the exam, students take on the identity of another student and obtain entry to the test hall. Students' laziness, their drive to get cash quickly, and their search for a shortcut to success all contribute to this. Test-impersonation's effects include indolence among conscientious students, students who are ill-prepared, and a damaged reputation for educational institutions as a result of students who are unable to successfully compete with their peers.

Researchers and developers have created a number of Web-Based Assessment Tools (WBAT) to lessen the difficulty of examination impersonation in an effort to limit this expanding problem. Because users could get around these unimodal systems, they faced problems. As a result, Web-Based Assessment Tools (WBAT) that mix two or more elements were developed. To address the problem of impersonation, the Web-Based Assessment Tool (WBAT) will guarantee enhanced security and develop a two-phase approach.

Nevertheless, a number of Web-Based Assessment Tools (WBATs) have been created in the past, but server-side scripting software like PHP was not well utilized, and the systems were unable to record attendance or identify impersonators during tests. Since impersonation is becoming a bigger problem in Nigeria, a more reliable and secure system is required to assist in managing examination impersonation situations. In order to evaluate students' exams at smart basic schools in Enugu state, this study created an Interactive Web-Based Assessment Tool (IWBAT). In particular, the research:

1. Established the requirements specification for the Interactive Web-Based Assessment Tool (IWBAT).
2. Designed an architecture for the Interactive Web-Based Assessment Tool (IWBAT) based on the software requirement specification.
3. Developed the Examination Interactive Web-Based Assessment Tool (IWBAT) according to the architectural design.
4. Determined the extent to which the Interactive Web-Based Assessment Tool (IWBAT) developed conform to the requirement that guided its design. (Alpha Testing).
5. Conducted a user review on Interactive Web-Based Assessment Tool (IWBAT) developed whether it conforms to the requirements that guided its design (Beta Testing).

Procedures Used

A reward and development (R&D) design was used in this investigation. Developing an Interactive Web-Based Assessment Tool (IWBAT) to identify exam impersonation at smart basic schools was the goal. The study's population was divided into four groups according to the stages that went into creating the IWBAT. The population for the requirement specification in Phase 1 consisted of 39 respondents, including 4 software architects and 35 professors. 39 respondents (4 software architects and 35 professors) made up the population for phase II's assessment of the IWBAT's architectural plan. In phase IV, the population for the IWBAT's test phase/Apha testing consisted of 39 responders (4 software architects and 35 lecturers). In phase V, the population for the IWBAT review and beta testing consisted of 200 students and 35 lecturers. There are 235 people in phase V. The study's overall sample size is 239 people. In accordance with the study's goal, five research questions were created. Throughout the five stages of the development process, two questionnaires, MEQ and MUG, were created to gather data from the respondents. V is 235. The study's overall sample size is 239 people. In accordance with the study's goal, five research questions were created. To gather data from the respondents throughout the five stages of the IWBAT development process, two questionnaires, MEQ and MUQ, were created. Three professors from the University of Nigeria, Nsukka's Department of Computer and Robotics Education verified the instruments. Cronbach alpha was used to assess the instruments' reliability, and the results showed reliability coefficients of 0.71 and 0.63, respectively. Based on the stages of research and development, the following procedures were used to accomplish the study's goals.

Phase 1: Users Needs Assessment and Software Requirement Analysis: A needs assessment was carried out to determine the IWBAT specification based on the traits of the study's target population.

Phase II: Design of the IWBAT: At this phase, the blueprint such as the architectural flow diagram and the use case view of the IWBAT were designed. Also, the software tools for the development of the IWBAT were selected.

Phase III Development of the IWBAT: At this phase, the IWBAT was developed according to the blueprint that guided the design.

Phase IV: Functionality Test/Alpha Testing: A group of academics and software architects validated the Interactive Web-Based Assessment Tool (IWBAT) prototype to find and fix and errors and make sure it followed the specifications that shaped the MEBTS's

Phase V: User Review/Beta Testing: The Interactive Web-Based Assessment Tool (IWBAT) prototype was validated. Expert validation and student-specific validation were used in the IWBAT's beta testing. Students studying computer studies and other subjects at the five smart schools in Enugu State used the developed IWBAT.

Major Findings of the Study

Based on the data collected and analysed, the following major findings were made:

1. IWBAT was designed to meet the following major software Requirement Specification (SSS)
    a. Web-based Assessment software is highly required
    b. Compatibility with Windows operating systems is highly required, compatible with 32-bit and 64-bit systems PHP software and the flask database.
2. Finding from research question two showed that the following are highly appropriate for the architectural design of the developed Interactive Web-Based Assessment Tool (IWBAT) as follows, the architectural flow diagram, the user interface design. The use case view, the technical design and the quality verification and validation.
3. Finding from research question 3 showed that the IWBAT was rated excellent on the extent of conformity to architectural design.
4. The ability to accommodate large classes.
    a. Stability over a long time.
5. The result of the Alpha test indicated that the IWBAT performed above the benchmark and rated for continuity.
6. The result of the user review/Beta test indicated that the IWBAT performed above the benchmark in the beta testing (Lecturer and student validation).

7. The study revealed that the user experience of the IWBAT by students across smart schools in Enugu State was rated as excellent. This shows that the IWBAT is a good solution to the challenges of examination impersonation in the smart schools in Enugu State.

Implication of the Findings

The study's conclusions have ramifications for researchers, instructors, curriculum designers, and students in a variety of subject areas.

According to the study's findings, integrating the Interactive Web-Based Assessment Tool (IWBAT) will improve students' academic performance and learning experiences while encouraging academic excellence and upholding the integrity of tests. While lazy students understand that dishonest students can no longer get undeserved praise for their academic achievements, diligent students are inspired to put in more effort.

The results demonstrate the potential of the Interactive Web-Based Assessment Tool (IWBAT) to detect impersonators and reestablish trust in the testing procedure. This is how instructors should interpret the findings. Furthermore, professors may take attendance and confirm students' identities with little to no human intervention or influence, which eventually produces the best competent individuals for society.

The study's findings give curriculum designers additional confidence in the safety of computer-based tests since the Interactive Web-Based Assessment Tool (IWBAT) successfully tackles impersonation concerns. This will also encourage curriculum designers to endorse the use of computer-based tests for large groups of students. Curriculum designers outside of the smart school may also use the IWBAT. The study's conclusions have important ramifications for school owners, whether they are privately held or government-run.

The IWBAT's implementation will ensure that only exceptional pupils are accepted into society and that students' laziness is not accepted. It will also lead to improved enrollment rates, access to finding, and other opportunities, as well as higher institutional evaluations.

In order to conduct exams more successfully, accredited testing organizations like the Joint Admission Matriculation Board (JAMB) and the West African Examination Council (WAEC) would make the most use of the Interactive Web-Based Assessment Tool (IWBAT). Although JAMB currently employs a unimodal method, the IWBAT will increase security and guarantee that exams are administered in a more secure way.

Conclusion

The creation of the Interactive Web-Based Assessment Tool (IWBAT) (MFBIS) was informed by the requirements acquired during the needs assessment. The system underwent development in accordance with an architectural blueprint. The developed IWBAT was put through a number of validation procedures, such as beta and alpha testing, and the results showed that the program complies with the requirements derived from the need analysis. During the beta testing phase, the developed IWBAT was subjected to additional testing to provide students a firsthand look at how to use it. According to the study's findings, students were motivated to see the IWBAT implemented because they believed it would improve exam security and offer deserving incentives to students who worked hard.

Recommendations

Based on the findings of the study, the researcher recommends the following:

1. The developed IWBAT should be adopted by Tertiary Institutions for the successful conduct of Computer Based Examinations and Improved security in the student’s halls of residence.
2. The developed IWBAT should be adopted by teachers in various disciplines for the running of classes, taking of electronic attendance and the conduct of Computer based quizzes and semester

examinations as it will ensure that only the appropriate students are allowed for classes and allowed to take their examinations.

3. The developed IWBAT should be adopted by examination bodies such as WAEC and JAMB for use in national examinations to avoid reoccurring cases of examination impersonation and restore utmost confidence in the examinations conducted by these examination bodies.
4. The developed IWBAT in this study should be adopted by various private and public organizations involved in mass recruitment of staff and personnel for the conduct of computer-based examination and promotional examination.
5. Private companies and organizations should adopt the developed IWBAT for access control into their buildings and facilities to avoid undue access and security breaches.

Limitation of the Study

1. The inconsistency in power supply resulted in a delay during the Beta resting phase involving students from tertiary institutions. This delay was mostly attributed to the adverse impact on face matching, which was exacerbated by inadequate lighting conditions in the classrooms.
2. The study was limited to smart schools in Enugu State and limited the generalization of the findings.

Suggestion for Further Studies

From the findings of this study the following further research are suggested:

1. Development of an Interactive Web-Based Assessment Tool (IWBAT) for secondary schools in Nigeria.
2. Development of an interactive system for Computer based examination in smart schools in Enugu State.

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APPENDICES

Appendix A – Population Sample Table

Sample of Participating Schools and Respondents

S/N	School Name	LGA	Number of Respondents	Role (e.g., Teacher/Student)	Signature
1	Smart Basic School, Nsukka	Nsukka	10	Teachers	____________________
2	Model Primary School, Enugu	Enugu North	10	Teachers	____________________
3	Urban Smart Academy, Agbani	Nkanu West	8	Students	____________________
4	Ideal Digital School, Oji River	Oji River	7	Teachers	____________________
5	Sunrise Smart School, Udi	Udi	10	Students	____________________

Total Sample Size: 45 respondents

Sampling Technique: Purposive Sampling (based on schools with smart/digital facilities)

Appendix B – Questionnaire Sample
Title:

Questionnaire for Teachers and Students on the Development and Integration of a Web-Based Assessment Platform in Smart Basic Education Schools

Dear respondent,
You are kindly requested to respond to the questions below. This is strictly for academic research purposes. Your answers will be treated with confidentiality.

Section A: Demographic Information
1. Name (Optional): ____________________________

2. Gender: ☐ Male ☐ Female

3. Age: ☐ 18–25 ☐ 26–35 ☐ 36–45 ☐ 46+

4. School Name: ____________________________

5. Role: ☐ Teacher ☐ Student

6. Years of Experience (if teacher): ____________

Section B: Awareness and Usage of Technology
7. Does your school use smart technology in teaching? ☐ Yes ☐ No

8. Have you ever used a computer or tablet for assessments? ☐ Yes ☐ No

9. Rate your computer skills: ☐ Poor ☐ Fair ☐ Good ☐ Excellent

Section C: Need for a Web-Based Assessment Platform
10. Do you think an online assessment platform will improve learning? ☐ Yes ☐ No ☐ Not Sure

11. Which features would you like to see in the platform? (Check all that apply)

☐ Instant Feedback

☐ Result History

☐ Timed Quizzes

☐ Gamified Learning

☐ Teacher Monitoring Dashboard

12. Are you willing to be trained to use such a platform? ☐ Yes ☐ No

13. Any suggestions for improving digital assessments in your school?

____

____

Thank you for your participation!

Signature (Optional): ____________________