

MSc Dissertation Report

“Building an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector” (Case Study of Anchor Heights School)

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Sheffield Hallam University for the degree of Master of Science in
Information Technology Management

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Abstracts

This research endeavours to address challenges in student result management in Nigerian secondary schools, exemplified by the case study of Anchor Heights School. The study proposes implementing an Automated Student Result Management System (ASRMS) and emphasises the need for a careful approach to mitigate potential social harms. Utilising a scoping review method, the research explores the impact of technology on education, incorporating the Unified Theory of Acceptance and Use of Technology (UTAUT) framework to understand user behaviour.

The methodology encompasses a pragmatic research philosophy, integrating positivism and interpretivism, adopting an abductive research approach. The case study strategy involves Anchor Group of Schools, employing purposive sampling for participants with technology implementation expertise. Ethical considerations, transparency, and compliance are diligently observed throughout data collection and analysis, employing quantitative and qualitative methods.

The subsequent implementation phase adopts a qualitative, exploratory approach, employing semi-structured interviews to discern the optimisation potential of information technologies and business process automation in student result management. Thematic analysis of interviews with a Principal and a Data Entry Officer reveals key themes: Efficiency and Accuracy, User Accessibility, Enhanced Educational Processes, and Data Security and Privacy.

The research then transitions to the development process of the ASRMS, guided by UTAUT and employing Rapid Application Development methodology. It outlines functional and non-functional requirements, prioritising features using the Kano Model. The system design phase introduces use case diagrams, actor descriptions, and design artefacts for effective communication and clarity.

In summary, this research provides a comprehensive understanding of stakeholder perspectives, paving the way for the design and implementation of an ASRMS aligned with the needs and expectations of the Nigerian education sector. Participants' positive reception underscores the proposed system's potential success and impact, emphasising improved efficiency, accuracy, and user satisfaction. The research contributes valuable insights into educational management and technology integration in the Nigerian context.

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Chapter One

Introduction to Research

1.0. Introduction

1.1. Background of Study

Effective educational management is pivotal for growth in educational institutions (Heck & Hallinger, 2005). Ranging from primary schools to universities, these institutions bear the responsibility of ensuring a fertile ground for learning, knowledge sharing, and skill honing. Connolly et al. (2019) highlight the multifaceted nature of educational management, encompassing activities such as strategic planning, administrative coordination, curriculum development, and teacher-student interaction (p. 505). These activities collectively equip institutions to foster academic excellence, innovation, and a passion for lifelong learning (Heck & Hallinger, 2005).

Amidst the complex educational management landscape, Nigerian secondary schools, including Anchor Heights School, grapple with several pivotal challenges, notably the manual result management process (Añulika et al., 2014; Nmaju et al., 2013). These prevalent inefficiencies impede academic progress and underscores the need for a transformative solution. The implementation of an Automated Student Result Management System (ASRMS) is poised to revolutionise the way academic data is handled, offering streamlined processes and heightened efficiency (Rajpurohit et al., 2022). This study aims to address these challenges by proposing the implementation of an Automated Student Result Management System (ASRMS) tailored for Anchor Heights School. As we delve into the multifaceted world of educational management, the focus on streamlining result processing at Anchor Heights School becomes imperative for enhancing efficiency, reducing errors, and promoting a dynamic learning environment.

1.1.1. Statement of Problem

Examining educational management highlights the pivotal role of efficient student result handling for academic success (Akinmosin, 2014). Ezenwa et al. (2014) warned against the risks of manual

processing, emphasising potential repetitive activities. Figure 1.1 delineates additional challenges in this context.

Challenges	Conception	Benefits of an Automated System
Delayed Handling of Results	The time constraints faced by teachers in the manual processing of results, especially within the limited timeframe from the end of exams to vacations, necessitate a more efficient and timely approach.	Efficient and Timely Processing: Automation streamlines the workflow, reducing the time and effort required by teachers for the prompt publication of results.
Inadequate Document Security	The vulnerability of printed documents to loss and damage, along with the risk of unauthorised access by intruders, underscores the need for a more secure result management system.	Enhanced Document Security: Implementing digital storage with robust security measures safeguards data against loss, damage, and unauthorised access.
Generation of Substandard Results	The potential for human errors due to teacher fatigue underscores the importance of a system that can minimise inaccuracies in calculating scores and grades, ensuring the release of precise and reliable results.	Accuracy in Result Production: Automation minimises human errors, ensuring the precise computation of scores, averages, and grades.

Figure 1: Challenges of the existing student result management process in Anchor Heights School (Adapted from Ojo & Akhigbe, 2020)

Despite computers' potential to streamline admission procedures, examinations, registration, staff scheduling, and record-keeping, secondary school authorities often confine their use to desktop applications. Consequently, manual preparation persists in tasks like results processing, reflected in the creation of statements, broadsheets, and summaries (Dada et al., 2017, p. 131). This is as seen in the case of Anchor Heights School.

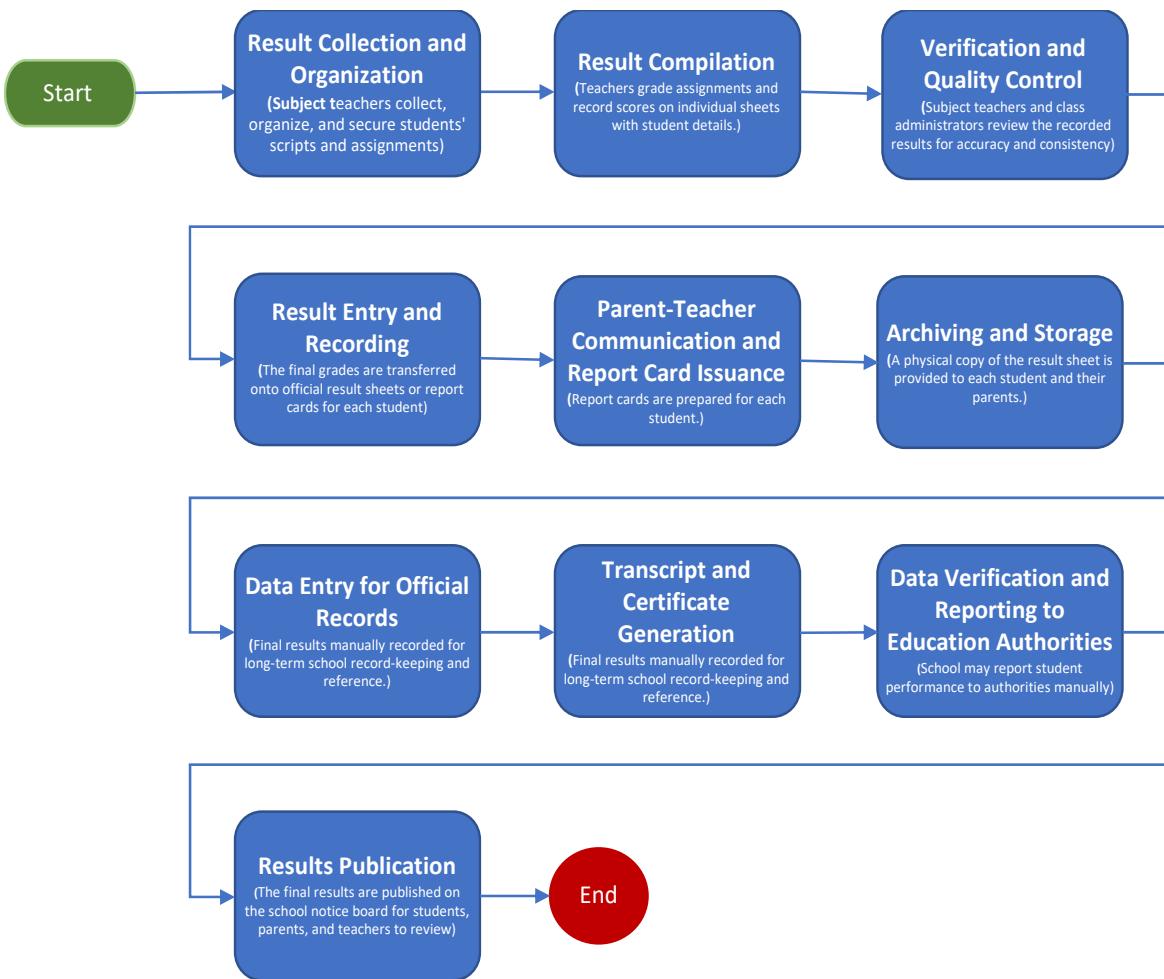


Figure 2: Manual result handling process of Anchor Heights School (Akintunde, 2023)

Efficient student result management involves collecting, organising, and disseminating academic performance data, forming the bedrock for evaluating educational quality and effectiveness (Lumby, 2017). It significantly influences the trajectory of educational institutions and the futures of their students, ensuring accessible academic information for stakeholders, empowering tailored teaching methods, providing parental support, and aiding informed decision-making for administrators (Dada et al., 2017). Accessible academic information empowers stakeholder groups: students, parents, educators, and administrators (Akinmosin, 2014), facilitating active participation in the educational journey (Ramesh et al., 2021, p. 329). Students can closely monitor their progress, educators can tailor their teaching methods, parents can provide essential support, becoming true partners in their child's educational voyage and administrators can make informed decisions regarding curriculum enhancements and resource allocation with precision.

In a technologically transformed educational landscape, the infusion of educational technology is imperative (Richey, 2008). Educational technology encompasses the ethical application of methods to facilitate learning and improve performance through dynamic design, development, utilisation, management, and evaluation of processes and resources (Lowenthal & Wilson, 2010; Richey, 2008). Educational technology promises enhanced efficiency, offering tools like Learning Management Systems (LMS) facilitating online learning to Student Information Systems (SIS) streamlining administrative tasks (Barrett, 1999; Dobre, 2015). Learning Management Systems (LMS) manages administration, tracking, and education delivery, while Student Information System (SIS) organises student accountability data, and fosters education through inquiry and analysis (Barrett, 1999).

Within this technological spectrum, an Automated Student Result Management System (ASRMS), an aspect of the Student Information System (SIS) (Akinmosin, 2014), emerges as a transformational tool for educational institutions. Ojo & Akhigbe (2020, p. 2) opined on the potential of the system to streamline administrative processes, minimising errors, ensuring accuracy and securing academic records. An Automated Student Result Management System (ASRMS) efficiently collects, analyses, securely stores, and provides real-time accessibility to student results, simplifying administrative processes and empowering students and parents to monitor progress seamlessly. Furthermore, such a system can facilitate data-driven decision-making, as educators and administrators can analyze aggregated academic data to identify areas for improvement, ultimately leading to elevated educational standards (Singh & Dev, 2023).

In the context of the Nigerian educational sector, adopting an Automated Student Result Management System can address the existing challenges associated with manual record-keeping and result management, aligning with global trends in educational administration and technology integration (Barrett, 1999; Eludire, 2011; Nmaju et al., 2013; Ukem et al., 2012; Vecchioli, 1999). This transition reflects a commitment to enhancing educational efficiency, accuracy, and accessibility on par with institutions worldwide.

1.2. Research Question, Aim, Objectives and Deliverables

As we delve into the research questions and objectives, it becomes apparent that each query and goal is intricately woven into the fabric of addressing the identified challenges. From critically examining existing administrative processes to developing a tailored ASRMS, every step in our research journey is a deliberate effort toward overcoming the hurdles faced by educational institutions. Let's explore how each research element aligns with the broader mission of enhancing efficiency, reducing errors, and promoting a dynamic learning environment for institutions like Anchor Heights School.

1.2.1. Research Question

How can the development and implementation of an Automated Student Result Management System enhance administrative efficiency, academic experience and contribute to educational progress in Secondary Schools within the Nigerian educational landscape?

1.2.2. Aim of the Research Project

This project aims to develop and implement an automated student result management system that will empower educational institutions to streamline and optimize administrative processes, resulting in improved academic experiences, and drive educational progress for students, educators, and educational administrators within the Nigerian educational sector.

1.2.3. Objectives of the Research Project

The research study will address the following objectives:

- To critically examine the existing administrative processes within Nigerian secondary schools and identify areas where automation can streamline and optimize these processes.
- To develop an automated student result management system that aligns with the specific needs and requirements of educational institutions in the Nigerian context, enhancing the academic experiences of students and educators.

- To evaluate the impact of the implemented automated student result management system on administrative efficiency, academic experiences, and overall educational progress within secondary schools in the Nigerian educational landscape through empirical research and data analysis.

1.2.4. Deliverable

To build an Automated Student Result Management System (ASRMS) that will streamline and optimize administrative processes, and improve academic experiences and data-driven decision-making for educational institutions, policymakers, students, educators, and administrators within the Nigerian education sector.

1.3. Significance of the Study

This study identifies and tackles critical challenges in student result management, introducing the Automated Student Result Management System (ASRMS) as a transformative solution. Confronting issues like delays in result publication, inaccuracies, and administrative inefficiencies, the ASRMS emerges as a pivotal technological innovation.

To combat delayed result publication, the ASRMS streamlines administrative processes, ensuring swift and accurate dissemination. Beyond technological upgrades, it will serve as a catalyst for positive change, fostering academic excellence through seamless result calculation and grading automation. The system will actively contribute to an improved academic environment, promoting efficiency, accuracy, and accountability with its user-friendly interface.

Progress will be measured through metrics like reduced publication time, decreased errors, and increased satisfaction among educators and students. Positioned as a catalyst for progress in education, the ASRMS aims to streamline processes, foster excellence, and create a positive impact on educational institutions nationwide, extending beyond Anchor Heights School to influence secondary schools throughout Nigeria.

1.4. Definition of Terms

Throughout this dissertation, certain terms are used with specific meanings:

- **Educational Management:** This concept involves strategically planning, coordinating, overseeing, and regulating activities within a learning environment to achieve academic excellence (Gu, 2022, p.59).
- **Student Result Management:** The management of student results, including the recording, processing, storage, and dissemination of academic performance data.
- **Educational Technology:** This concept involves the methodical and structured utilisation of contemporary technology to enhance the quality of education, emphasising efficiency and optimization (Stošić, 2015).
- **Automation:** The application of sophisticated technological systems and processes in education to substitute human labor, leading to heightened operational efficiency (Selwyn et al., 2023).
- **Automated Student Result Management System:** An educational technology designed to manage student results efficiently and transparently, including its key features and functionalities (Rajpurohit et al., 2022).
- **Process Automation:** A concept entails creating and deploying software to mechanise procedures with minimal human involvement (Amin, 2022).
- **Technology Acceptance/Adoption:** This concept encompasses the integration and embracement of technology, while also focusing on the essential criteria that users require for contentment with the respective technology (Granić, 2023).
- **Anchor Heights School:** A case study educational institution located in Ogun State, Nigeria used for this research.

1.5. Research Assumptions and Limitations

This section delineates the assumptions and constraints inherent in the research, establishing the foundational structure for the study. Kirkwood & Price (2013) articulates a framework of assumptions and limitations enabling the researcher to focus on the most pertinent themes, employing established research guidelines in the absence of predefined boundaries.

1.5.1. Assumptions

The research relies on several assumptions, including the presumption that the availability of data and resources may pose limitations. Furthermore, it assumes that Anchor Heights School's challenges represent broader issues within Nigerian educational institutions. Additionally, the research assumes stakeholders in the education sector are receptive to the adoption of educational technology solutions.

1.5.2. Limitations

The research is subject to various limitations that revolve around data availability, resource constraints, and participant accessibility. Additionally, external factors such as policy changes and economic conditions may impact the feasibility and implementation of an Automated Student Result Management System. Moreover, the generalisability of findings is constrained due to the focus on a single case study (Anchor Heights School), limiting universal applicability to all educational institutions in Nigeria.

1.6. Research Process Overview

This research, focusing on developing an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector, involves a comprehensive exploration. It critically reviews relevant literature, outlines research aims, objectives, and questions. The methodology covers interview procedures, participant characteristics, and data analysis techniques. A proof of concept for the system was developed, executed, and tested based on user feedback. Conclusions and recommendations are drawn, addressing the specific context of the

Student Result Management System for secondary schools, while identifying potential avenues for further research within this domain.

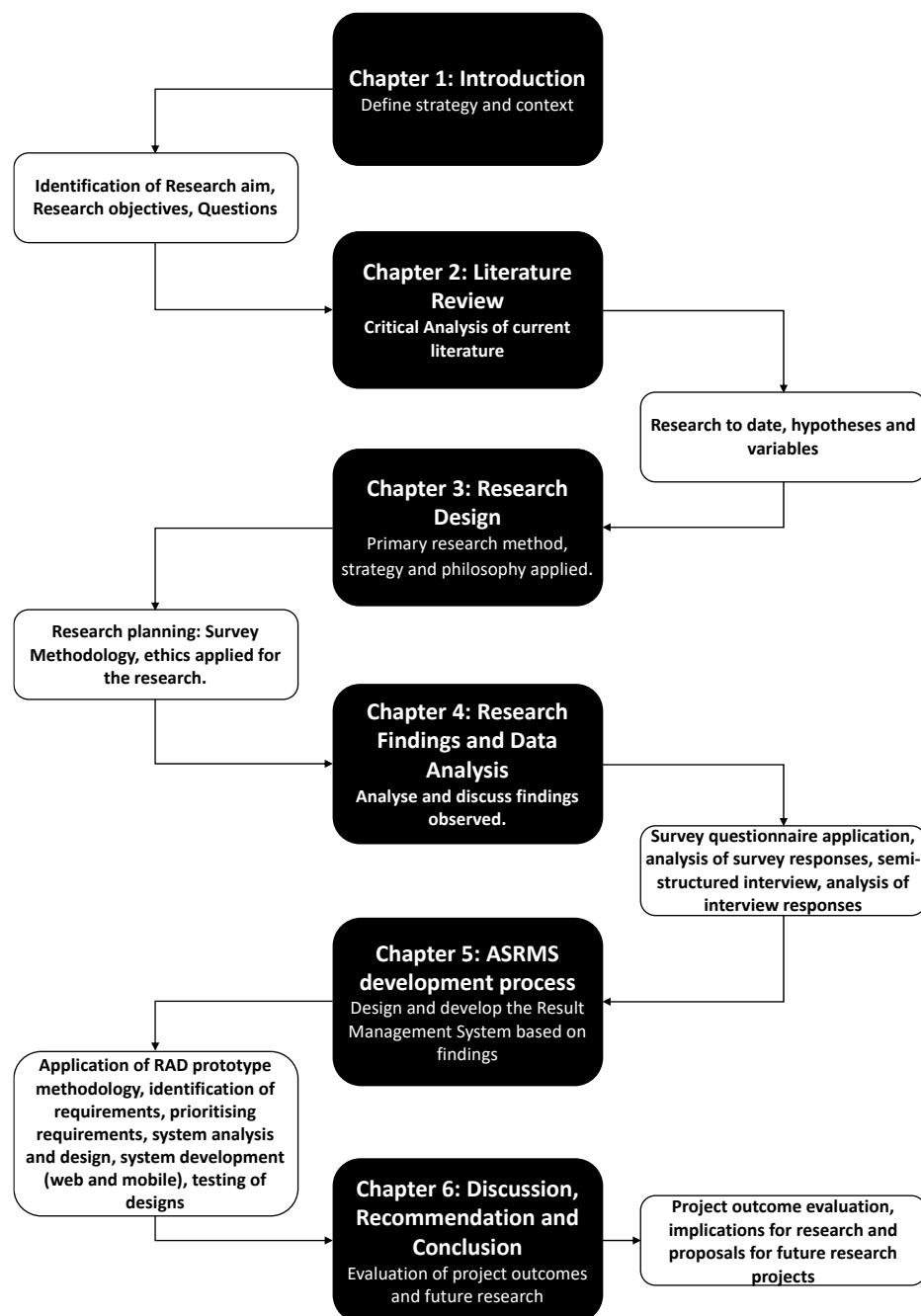


Figure 3: Overview of the Research Process (Source: Akintunde, 2023)

1.7. Chapter Summary

This chapter introduces the importance of effective educational management, specifically addressing challenges in student result management in Nigerian secondary schools, using Anchor Heights School as a case study. It proposes the implementation of an Automated Student Result

Management System (ASRMS) and outlines research questions, aims, objectives, and deliverables. The significance of the study, definition of terms, research assumptions, limitations, and the research process overview are also presented.

Chapter Two

Literature Review

2.0. Introduction

This chapter extensively explores critical themes in developing an Automated Student Result Management System in Nigerian secondary schools. Focused on technological infrastructure and process automation in educational management, it constructs a robust research framework drawing insights from diverse papers. This guides the proof of concept for a software application dedicated to streamlining result management. The literature review delves into various perspectives and methodologies, aiming to understand the practical implications and potential impact of implementing such a system in education. The outlined search strategy details the research plan, emphasising three central themes: technological infrastructure, user perspectives on automated systems, and security and privacy in ASRMS, with systematically assessed sub-themes.

2.1. Search Strategy

This research adopted a scoping review method to synthesise literature from diverse sources, including peer-reviewed journal publications, textbooks, grey literature, and other relevant materials (Munn et al., 2018; Verdejo et al., 2021, p.3). Munn et al. (2018) emphasised that the scope review approach, encompassing both qualitative and quantitative research, facilitated the collection of information on the foundational concepts of the research topic (p. 4). A structured process (p. 1) guided the selection of literature, utilising predefined criteria with keywords such as "technological infrastructure in education," "result management automation," "process and system automation," "educational management," and "Nigerian secondary school education" to distinguish apposite literature (Gough et al., 2012; Tricco et al., 2016). This strategy ensured the identification of pertinent studies while acknowledging their limitations and contributions to the ongoing research.

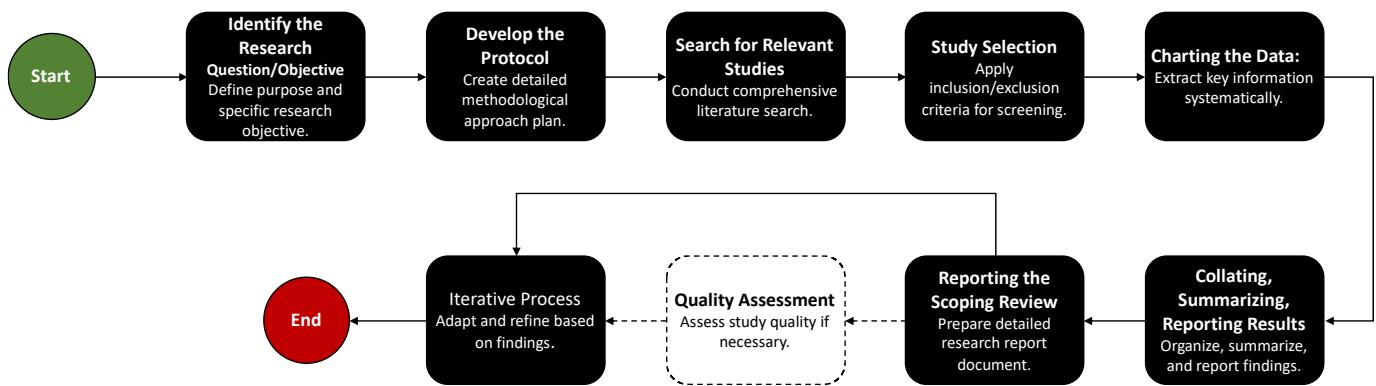


Figure 4: General outline of the scoping review method (Adapted from Colquhoun et al., 2014, p. 1293).

2.2. Current Position Assessment of Student Result Management

2.2.1. Current Student Result Management Process in Nigerian Secondary Schools.

The current state of the student result management process in Nigeria is a pressing concern that demands immediate attention (Alabi, 2017). Despite the efforts made by the government and educational institutions, the system continues to face significant challenges that require urgent attention. The lack of a centralised and standardised system has led to cases of missing results, errors in grading, and delays in the release of results undermines the entire system's credibility (Ibrahim & Ebole, 2020; Ndukwe & Obiorah, 2019). Manual result computation has led to the problem of computational error, insecurity of results, and untidy results after changes (Añulika et al., 2014; Grey, 2010). Such issues can impede students' academic progress and limit student career prospects, which is unacceptable.

The crucial role of managing and analysing student results in the educational system involves offering valuable insights into students' academic performance, monitoring their progress, and identifying areas for improvement (Ajayi & Ekundayo, 2011; Haertel et al., 2007). Consequently, to address these challenges, a comprehensive reform that involves embracing modern technologies, establishing a centralised database, implementing strict measures to curb exam malpractice, and prioritising training for teachers and examiners needs to be established.

2.2.2. Implication of the System (ASRMS) on Education.

Implementing an automated student result management system in Nigeria's education sector offers numerous benefits (Aitymova et al., 2022; Ndukwe & Obiorah, 2019). The automated system brings about long-term cost reduction by minimising manual processing and paperwork and offers instant feedback to students, facilitating progress tracking and necessary improvements (Ogochukwu, 2022; Yusuf et al., 2022). The automated system enhances documentation accuracy and accessibility, thereby ensuring digital records of students' growth (Ndukwe & Obiorah, 2019; Selwyn et al., 2023; Yusuf et al., 2022). Consequently, it improves result processing efficiency and saves time for both students and administrators (Ogochukwu, 2022, p. 91; Selwyn et al., 2023).

Añulika et al. (2014) tackled manual result processing challenges in Nigerian secondary schools by creating a PHP and MYSQL-based automated system. The solution reduced time and effort for result preparation, alleviating teacher stress and providing more time for instructional matters. In contrast, Selwyn et al. (2023) cautioned against potential social harms from automated systems in education. They highlighted the importance of holding these technologies accountable, citing discriminatory outcomes and failures in online exam proctoring systems as examples. This diverse perspective emphasises the need for a careful and nuanced approach, considering both benefits and ethical and social implications in education technology implementation (Ogochukwu, 2022).

2.3. Technological Infrastructure in Educational Management

The infusion of technology into education globally, particularly in emerging economies like Nigeria, has fundamentally transformed learning and instruction. Dede (2010) underscores that this shift alters how students interact with information, educational content, and educators. Haleem et al. (2022) further assert that technology facilitates the seamless operation and effective implementation of various educational processes.

Studies often examine challenges and opportunities in the sphere of technology integration in education. Carvalho et al. (2022) focus on challenges faced by Brazilian university teacher

education in the era of the Alpha Generation, emphasising the need for educators to master digital technologies and adapt methodologies for adequate preparation in an ever-evolving educational landscape. In the Nigerian context, Ojo & Akhigbe (2020) address designing and implementing a Result result-processing system, providing practical considerations for integrating technology into educational management. Udeze et al. (2017) developed a PHP and MySQL-based Automated Student Results Management Information System for universities, prioritising automation and cost reduction, recommending preventive maintenance and mobile systems.

These studies collectively stress the importance of foundational transformation towards advanced technological solutions, exemplified by Automated Student Result Management Systems (ASRMS). Matemilayo et al. (2017) emphasise the necessity of robust technological infrastructure supporting the storage, retrieval, and processing of educational data. Ojo & Akhigbe (2020) highlight the harmonisation of hardware and software components in this infrastructure to create an environment conducive to streamlined educational management. The integration of Information and Communication Technology (ICT) plays a pivotal role in addressing 21st-century challenges, enhancing efficiency and precision in manual result compilation (Lowder & Regmi, 2020).

However, challenges persist, especially in regions like Africa, where technology integration with education is in its early stages (Lloyd, 2020, UNESCO, 2021). Achimugu et al. (2010) highlight policy responsiveness as a key challenge hindering the realisation of technology's full educational potential. Despite these challenges, establishing ASRMS represents a forward-thinking approach, paving the way for a more technologically advanced and efficient educational management system in Nigerian secondary schools.

Integrating technology in education offers advantages such as enhanced student engagement and access to diverse resources (Grimley et al., 2012; Schindler et al., 2017). However, potential drawbacks include concerns about excessive screen time, distractions, and reduced direct social interaction (Martin et al., 2012; Hew et al., 2016; Wood et al., 2012). There are also worries about

the reliability of online information and the need for verification (Martin et al., 2012). Furthermore, some argue that overreliance on technology may lead to the neglect of traditional learning methods and human interaction (Schindler et al., 2017; Wood et al., 2012). Striking a balance is crucial, acknowledging both the benefits and potential drawbacks while ensuring technology is used effectively to support student learning and development.

2.3.1. Computer-Based Result Processing System

Adopting computer-based systems for processing student results is a cornerstone in modernising educational management (Granić, 2022; Osunade et al., 2018). According to Shah (2014), these systems promise heightened efficiency and accuracy, mitigating errors and time constraints in manual processes.

Timotheou et al. (2023) conducted a non-systematic literature review using meta-analyses and scholarly databases to explore digital technologies' complex and multifaceted impact on education and factors influencing schools' digital capacity. The study reveals limitations tied to specific databases, prompting the authors to advocate for broader investigations. It underscores challenges in establishing causal relationships among diverse variables. It calls for more insights into ICT's impact on education, emphasising the need for diverse study approaches to understand comprehensively. The proposed study will explore efficient computer-based result-processing methods for educational management enhancement, exploring how cloud computing offers cost-effective solutions and the role of web-based portals in fostering improved stakeholder communication, addressing this research gap.

2.3.2. Implementing Web-based Technologies for Enhanced Communication

Within the educational ecosystem, web-based technologies have become indispensable tools. An exploration into the functions of these technologies is vital to comprehend their role in enhancing communication among teachers, students, parents, and administrators. This investigation aims to

illuminate how these platforms contribute to substantially improving overall educational management.

Madeira et al. (2009) introduced a pioneering student learning tool, harmonising web and mobile technologies for responsible energy use. Using Adobe Director, Adobe Flash, XML databases, Data Mining (Self-Organising Maps algorithm), PHP, and MySQL, they created a dynamic mobile and web-based system integrating tutorials, exercises, interactive animations, assessments, a chat room, and an evaluative game. This study draws inspiration from Madeira et al., aiming to enhance educational efficiency in Nigerian secondary schools through an Automated Student Result Management System (ASRMS). Leveraging Python, Django, and SQL, the research seeks to automate result processing, ensuring accuracy and timely dissemination. Tailoring the ASRMS to local needs streamlines administrative tasks, fostering transparency and accessibility and aligning with the global trend of technology-driven educational management in the Nigerian context.

2.3.3. Implementing Cloud Computing technologies for Educational Management

Cloud computing models offer a cost-effective solution for educational institutions, particularly in developing and managing automated student result systems (Karim & Rampersad, 2017). Ezenwoke et al. (2013) posited that cloud computing addresses unique challenges in online education, ensuring affordability, scalability, and accessibility, Nigerian Secondary Schools included. Recognising the cost-effective nature of cloud computing is vital for promoting equitable access to technological advancements in diverse educational landscapes (Malik et al., 2017).

Koch et al. (2012) conducted a detailed cost analysis of cloud computing in education, emphasising the transition to a pay-as-you-go model. They assessed three resource allocation methods: pre-allocation based on peak demands, reactive allocation based on current demand, and proactive allocation considering domain-specific information. The study recommended collaboration between educational institutions and cloud providers for improved service quality and cost reduction. The conclusion favoured a workload-aware, proactive allocation method for

economically delivering quality services. However, acknowledged limitations include assumptions in numerical analysis and a potential lack of generalisability. The proposed study aims to address cloud adoption challenges, security, privacy, and organisational barriers, incorporating case studies and surveys for diverse educational insights.

2.3.4. System automation in Nigerian educational institutions

System automation in Nigerian educational institutions represents a pivotal paradigm shift, ushering in transformative changes to traditional processes. Cakula et al. (2015) developed an automated learning support system to enhance collaboration between adult education institutions and enterprises. Employing a sociotechnical system engineering approach, their study centred on knowledge management and work-based learning. The conceptual model they introduced integrated knowledge sharing among institutions, trainees, and enterprises facilitated by intellectual agents. However, their research acknowledged challenges in managing vast amounts of information and keeping pace with technology's rapid evolution. The authors identified a gap in applying knowledge management and work-based learning for sustainable cooperation systems, they emphasised the necessity for easily functional systems. The proposed study aims to underscore local challenges, engage stakeholders, and ensure contextual relevance, leveraging Python, Django, and SQL. It will encompass a comparative analysis, exploring innovations and scalability. Crucial components encompass user acceptance, feedback mechanisms, and the broader implications of the system for elevating educational standards in Nigeria. By adopting a tailored approach that addresses local needs, the study strives to offer practical solutions to the prevalent result management challenges within the Nigerian education sector.

Similarly, Aljenaa et al. (2011) investigated crucial components for successful E-Learning implementation within the cloud computing framework, focusing on mitigating challenges in traditional E-Learning systems, especially regarding architecture and core components. The authors proposed a cloud computing-based framework to address these challenges, drawing

insights from the Kuwait Ministry of Education case study. The study, primarily conceptual and exploratory, outlines challenges associated with E-Learning and cloud computing, acknowledging limitations such as potential biases in the proposed model and its generalizability. It suggests research gaps for further empirical validation, exploration of specific challenges in adopting cloud-based E-Learning, and a deeper investigation into cultural and social aspects. The proposed study aims to integrate cloud computing into automating the Student Result Management System in Nigerian secondary schools, evaluating scalability and usability and addressing specific challenges, with lessons learned contributing to practical knowledge.

2.4. User Perspectives on Automated Educational Management Systems

The success of an Automated Student Result Management System (ASRMS) in secondary schools' hinges on the perspectives of end-users—students, teachers, administrators, and parents. Understanding their unique expectations and concerns is crucial for successful integration (Udeze et al., 2017, p. 8587). According to Ramesh et al. (2021), students appreciate the transparency and immediacy an SRMS provides, fostering responsibility and prompt identification of areas for improvement (Bharamagoudar et al., 2013, p. 2342). The positive impact on students is evident in the Anchor Heights School case study, emphasising a user-friendly interface and features enhancing the overall experience, including performance trend graphics and subject-wise analysis.

Añulika et al. (2014) addressed manual compilation inadequacies in Nigerian secondary schools' result processes by developing an efficient automated system using PHP and MYSQL. The software eliminated manual calculations, reduced processing time, and enhanced accuracy. Preliminary investigations identified issues in the manual process, leading to the proposal, design, and implementation of the new system. The application, featuring subject registration and result computation, proved efficient and flexible, though specific limitations were not explicitly mentioned. The research gap pertains to deficiencies in manual result processing, effectively addressed by the automated system. Future research could explore scalability, security

enhancements, and user feedback for continuous improvement, ensuring adaptability across educational levels.

Bharamagoudar et al. (2013) contributed significantly to educational technology by designing a Student Information Management System (SIMS) for colleges. The research focused on automating student information, faculty management, exam sections, and placement cells, addressing a gap in manual systems. Aligning with Bharamagoudar et al. (2013), the proposed study aims to improve comprehensive automation, user-friendly interfaces, and heightened security. Prioritising user perspectives through feedback sessions, training programs, enhanced communication features, and tailored system alignment with Nigerian educational needs are key focuses.

The Automated Student Result Management System (ASRMS) shifts teachers' roles, relieving manual administrative burdens and emphasising the importance of teachers' technological literacy. Adequate training is vital for a smooth transition. ASRMS provides administrators insights into academic performance, supporting trend analysis and targeted interventions. Active administrator involvement, as seen at Anchor Heights School, is crucial for successful integration. Parental influence underscores the need for a user-friendly interface and clear communication channels for academic updates.

2.5. Security and Privacy in the Automated Student Result Management System

The transition to automated systems in educational institutions, particularly Automated Student Result Management Systems (ASRMS), raises apprehensions regarding the security and privacy of sensitive educational data. (Selwyn et al., 2023). Implementing robust security measures is pertinent to ensure legal compliance and build trust among students, parents, and stakeholders (Miguel et al., 2017; Polonetsky & Tene, 2014). Fundamental to secure ASRMS operation are authentication and authorization mechanisms, defining user roles, and implementing the principle of least privilege. Okpamen (2013) stated that data encryption during transmission using protocols

like SSL or TLS prevents unauthorised interception. Regular automated data backups, both onsite and offsite, help mitigate the risks of data loss. Falana et al. (2021) emphasise establishing clear privacy policies that specify data collection purposes and access guidelines. Compliance with data protection laws, such as the Nigerian Data Protection Regulation (NDPR), is essential, and regular security audits ensure ongoing compliance and continuous improvement (Alamleh, 2020; Olukoya, 2022). Olukoya (2022) employs the generic framework proposed by Breaux and Anton (Breaux & Antón, 2008; Breaux et al., 2006) to model and analyse the Nigerian Data Protection Regulation (NDPR), extracting privacy and security requirements from the legislation.

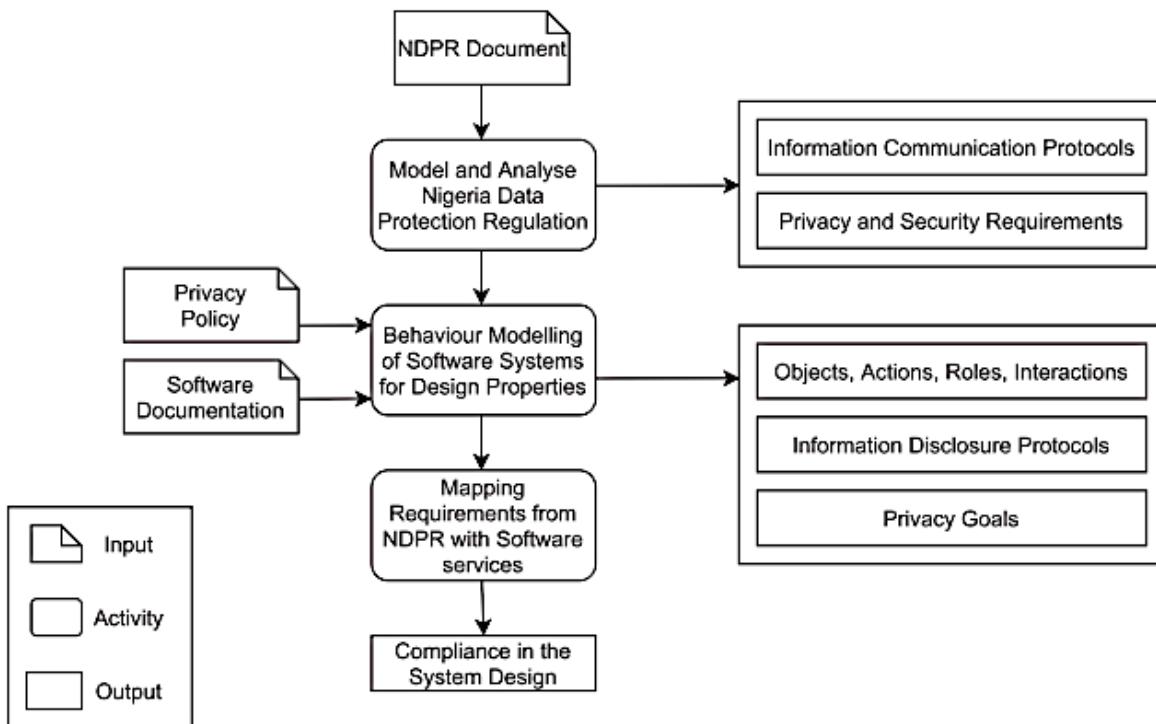


Figure 5: Privacy Verification Compliance Framework in Software Systems Using NDPR
 (Source: Olukoya, 2022)

Alier et al. (2021) examined global challenges in the educational system's digital transformation, focusing on data privacy in Learning Management Systems (LMS), Academic Management Systems (AMS), and online tools, referencing the General Data Protection Regulation (GDPR). Utilising 60 years of participative observation and legal framework analysis, the research identified difficulties in ensuring student privacy, incentives for data exploitation, and deficiencies

in privacy laws. Proposed solutions encompass technical, cultural, legal, and organisational dimensions, addressing complexities, ethical considerations, and technical challenges. The research gap lies in an ethical perspective deficiency. The proposed study intends to bridge this gap through strategies like data encryption, privacy education, legal enhancements, and organisational practices to fortify data privacy in education.

In a similar context, Sethi and Malhotra's (2023) research on the Efficiency Engine, an academic management system, provides an in-depth exploration of its background, objectives, methodology, and results, detailing modules such as user authentication and student management. However, limitations include a narrow focus on university/college education, needing more specificity on areas for Efficiency Engine improvement and distinctive features. Critical evaluation is absent, particularly regarding security and privacy, despite emphasizing the need for secure hosting. The research gap involves no comparative analysis, insufficient coverage of user experience and adoption challenges, limited discussion on the system's long-term impact, and a lack of exploration into stakeholder perspectives, data security, and privacy measures. To address these gaps, the proposed study will thoroughly examine security measures, assess user experiences and adoption challenges, evaluate the ASRMS's long-term impact on secondary education, and incorporate stakeholder perspectives through interviews or surveys for a comprehensive investigation.

2.6. Theoretical Framework

The Unified Theory of Acceptance and Use of Technology (UTAUT) serves as a comprehensive model developed to elucidate human behaviour in the context of technological innovation, specifically addressing how individuals respond to and adopt new technological solutions that cater to their needs and streamline their lives (Venkatesh et al., 2003). This theory has found application in understanding and predicting users' acceptance and usage behaviour of Information Technology (IT) and Information Systems (IS) applications and frameworks within various contexts, including education (Adejoh et al., 2021; Raman et al., 2014; Sezer & Yilmaz, 2019).

There is a growing need to integrate IT and IS applications to enhance institutional performance in the Nigerian education sector, specifically in student result management. Developing an Automated Student Result Management System for Secondary Schools is a critical initiative aiming to streamline processes and improve efficiency (Sethi & Malhotra, 2023).

UTAUT, among several other Technology Acceptance Models (TAMs), delves into the intricate dynamics of user acceptance and utilisation of technology (Rondan-Cataluña et al., 2015). The model concentrates on four primary factors—Performance Expectancy (PE), Social Influence (SI), Effort Expectancy (EE), and Facilitating Conditions (FC)— which collectively influence the strength of technology's impact on user behavior (Figure 2.4). These factors contribute to shaping behavioural intentions and subsequent user behaviour. Therefore, adopting UTAUT allows scholars to discern the aspects of technology that appeal to users, the reasons behind this appeal, and the extent to which the technology addresses the users' needs (Venkatesh et al., 2003). According to Venkatesh et al. (2003):

- Performance Expectancy (PE) refers to the technology's ability to deliver benefits and enhance user performance, meeting expectations. Users anticipate accurate, timely results, enriching educational processes (Mosweu et al., 2016).
- Effort Expectancy (EE) focuses on user perceptions of technology ease of use. System design aligns with expectations, minimizing input and analysis efforts (Afonso et al., 2012).
- Social Influence (SI) encompasses the expected impact of others on user technology adoption. Positive community perception influences adoption, emphasizing benefits (Mosweu et al., 2016; Kim et al., 2016).
- Facilitating Conditions (FC) involve anticipated organizational and technical infrastructure supporting technology use. Adequate resources and support are crucial in the Nigerian Education Sector (Donmez-Turan, 2019).

- Behavioral Intention (BI) refers to the user's expectation regarding their intention to implement plans and decisions concerning the use of the technology (Momani, 2020).

In addition to these primary factors, UTAUT incorporates four intermediate and individual variables—Gender, age, experience, and voluntariness of use—that contribute to predicting user behaviour and intention (Ayaz & Yanartas, 2020).

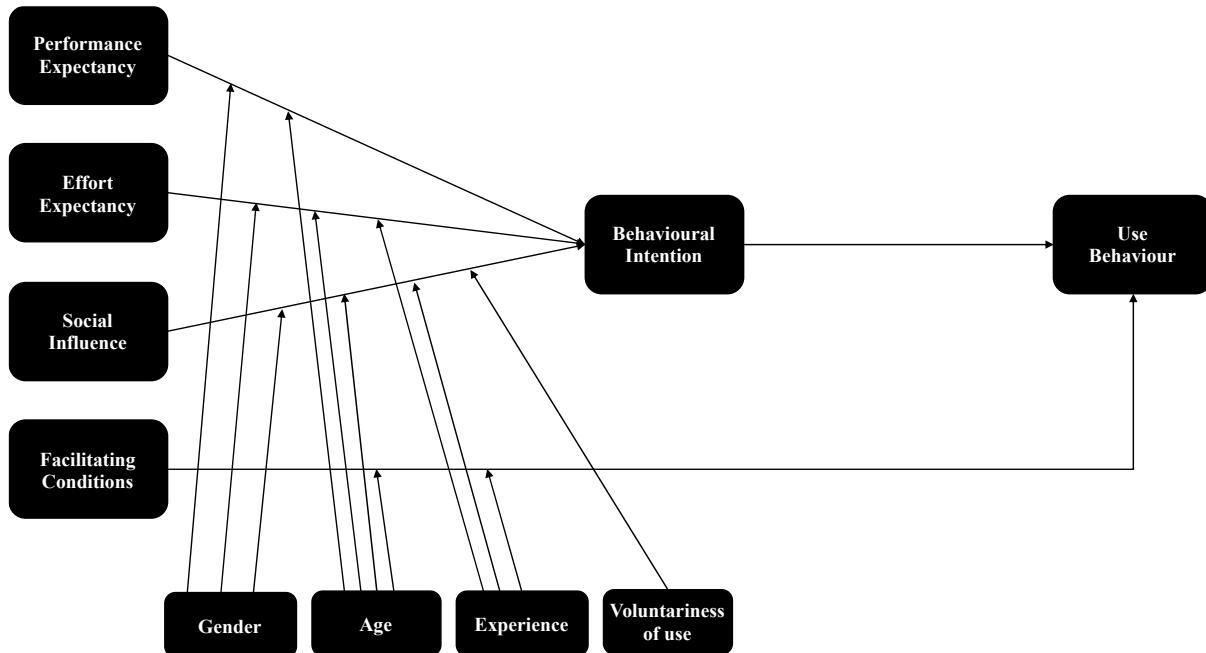


Figure 6: The Unified Theory of Acceptance and Use of Technology (Source: Venkatesh et al., 2003)

Despite its strengths, it is essential to note that UTAUT has limitations. It is part of a lineage of technology acceptance theories and may undergo adjustments in the future. Furthermore, UTAUT must comprehensively explain technology acceptance, as it overlooks essential demographic and socio-economic characteristics of technology users, such as the cost implications for usage (Momani, 2020).

For this research, the UTAUT framework will guide the exploration of dynamics related to implementing an Automated Student Result Management System within Secondary Schools in the Nigerian Education Sector. It will aid in identifying the critical factors influencing the acceptance and utilization of the system by teachers, students, and administrators, shedding light on the nuances of technology adoption in this specific educational context.

Table 1: Summary of reviewed literature and the proposed system

Author	Efficiency	Security	Scalability	Performance	Interactivity	Feasible	System type	Applicable for Secondary School
Carvalho et al. (2022)	Good	Good	Good	Good	Good	Yes	Web	No (University focus)
Ojo & Akhigbe (2020)	Good	Good	Good	Good	Good	Yes	Web	Yes
Udeze et al. (2017)	Good	Good	Good	Good	Good	Yes	Web	Yes
Matemilayo et al. (2017)	Good	Good	Good	Good	Good	Yes	Web	No (General Infrastructure)
Koch et al. (2012)	Good	Good	Good	Good	Good	Yes	Web	No (General Cloud Computing)
Timotheou et al. (2023)	Good	Good	Good	Good	Good	Yes	Web	No (General Digital Technologies)
Madeira et al. (2009)	Good	Good	Good	Good	Best	Yes	Web	Yes
Cakula et al. (2015)	Good	Good	Good	Good	Good	Yes	Web	No (Adult Learning)
Aljenaa et al. (2011)	Good	Good	Good	Good	Good	Yes	Web	No (E-Learning in general)
Bharamagoudar et al. (2013)	Good	Poor	Good	Good	Good	Yes	Web	No (College focus)
Ramesh et al. (2021)	Good	Good	Good	Good	Good	Yes	Web	No (General Academic Performance)
Añulika et al. (2014)	Good	Good	Good	Good	Good	Yes	Web	Yes
Sethi & Malhotra (2023)	Good	Good	Good	Good	Good	Yes	Web	No (University/College focus)
Alier et al. (2021)	Good	Good	Good	Good	Good	Yes	Web	No (Learning Management Systems)
Proposed System	Best	Best	Best	Best	Best	Yes	Web and Mobile	Yes

2.7. Chapter Summary

The chapter addresses the challenges in the current student result management in Nigerian secondary schools and the potential benefits of implementing an Automated Student Result Management System (ASRMS), emphasising the need for a careful approach due to possible social harms. The focus is on developing the ASRMS, covering technological infrastructure, user perspectives, and security. A scoping review method is employed to synthesise diverse literature, providing a robust research framework. The exploration of technology's impact on education, including computer-based result processing, web-based technologies, cloud computing, and system automation, is discussed. User perspectives and the significance of security and privacy in automated systems are highlighted. The Unified Theory of Acceptance and Use of Technology (UTAUT) serves as the theoretical framework for understanding user behaviour in adopting the proposed system, offering a comprehensive lens for analysis.

Chapter Three

Research Methodology

3.0. Introduction

This chapter introduces the research methodology employed in the study. It outlines a series of meticulously chosen steps, tools, and techniques tailored to the objectives of the study. The primary goal is to gain a comprehensive understanding of the specific requirements and challenges associated with automating result management in Nigeria's secondary education landscape, all the while meeting the expectations of the application users and incorporating their feedback into the design process. The research will employ a combination of research philosophy, strategy, and instruments in pursuit of its objectives and to address the research question (Davison, 1998; Ritchie et al., 2013). Prior to delving into the specifics, a preliminary assessment of the research strategy, approach, and anticipated outcomes is conducted to reaffirm the appropriateness of the selected methods and approaches for this study.

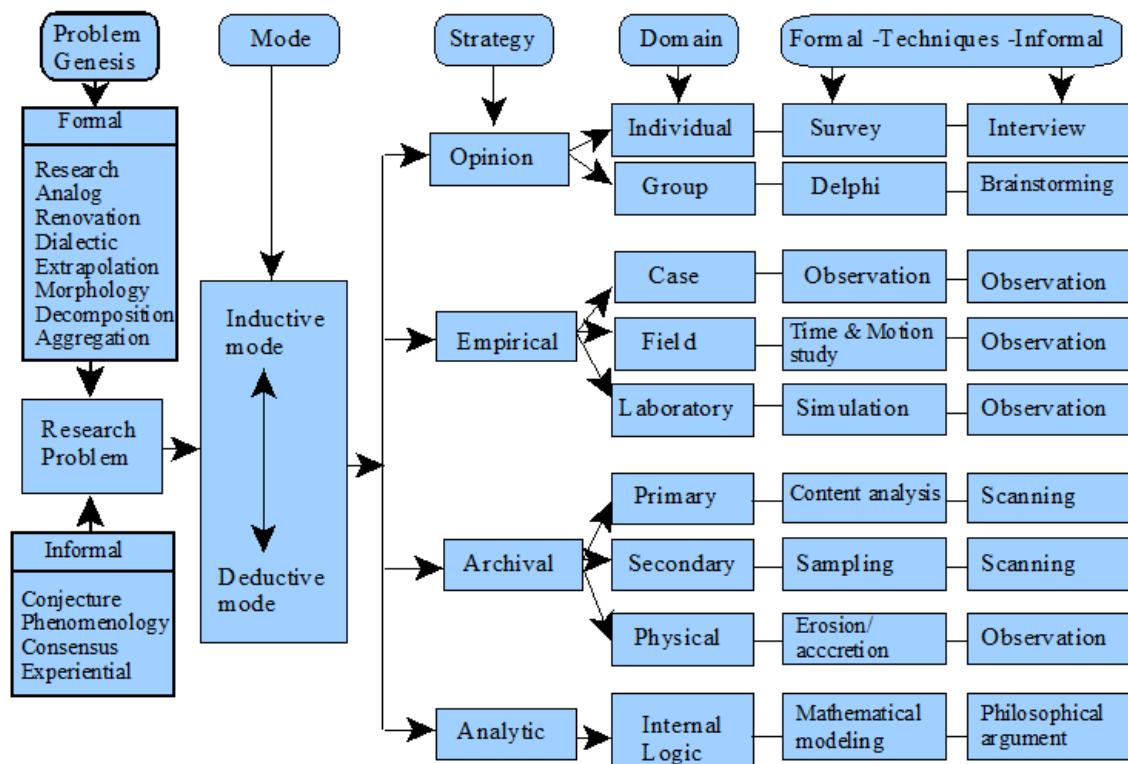


Figure 7: A framework for Research Methodology (Source: Adapted from Buckley et al., 1976)

3.1. Research Design

The research design, as outlined by Leedy & Ormrod (2015), serves as the comprehensive blueprint for collecting data to address the research question. A search strategy execution plan is a specific strategy outlining the selection of research participants, locations, and data collection procedures (Laksiri, 2021); Saunders et al., 2019). Saunders et al. (2019) further underscores the significance of comprehending the underlying factors and considerations within the research design, extending beyond just data collection and analysis techniques. Figure 3.1 provides a comprehensive framework for the research methodology, encapsulating the layers of research considerations, including philosophy, strategy, and instruments. This framework, adapted from Buckley et al. (1976), essentially represents the concept commonly known as the 'research onion,' illustrating the meticulously chosen steps, tools, and techniques tailored to the objectives of the study.

3.2. Research Method and Strategy

3.2.1. Research Philosophy

Research philosophy denotes the set of beliefs and assumptions steering a researcher's quest for understanding and knowledge (Davison, 1998; Holden & Lynch, 2004; Saunders et al., 2019). It plays a pivotal role in informing strategies, methods, and shaping the worldview of a researcher (Saunders et al., 2019). In the context of social science and business management studies, the pertinent dimensions are ontology and epistemology (Davison, 1998; Holden & Lynch, 2004; Laksiri, 2021). Ontology addresses one's conception of reality, questioning whether social entities are objective or subjective (Bryman, 2016; Laksiri, 2021). Meanwhile, epistemology delves into the sources and transmission of knowledge, exploring what is deemed acceptable, authentic, and legitimate (Crotty, 1998; Holden & Lynch, 2004; Saunders et al., 2019). Epistemological approaches such as positivism and interpretivism are common (Bryman, 2016; Laksiri, 2021). Axiology, the third facet of research philosophy, involves the study of values and the evaluation of knowledge's worth (Saunders et al., 2019).

3.2.1.1. Choosing a Researching Philosophy

Objectivism posits that external social entities and the objective reality of social occurrences exist independently of the interpretations and perspectives of social actors (Saunders et al., 2019). Saunders et al. (2019) highlighted that this approach contends that social processes and phenomena exist irrespective of the researcher's viewpoint, often employing scientific hypotheses and theories to comprehend these objective social entities and occurrences. Conversely, subjectivism emphasizes the role of social actors in shaping and continuously changing social phenomena and their significance through social interaction (Bryman, 2016; Saunders et al., 2019). According to Saunders et al. (2019), subjectivism tends to concentrate on exploring social phenomena based on the perspectives and experiences of social actors, frequently integrating arts and humanities perspectives.

Understanding the two primary tenets of research philosophy, positivism and interpretivism, is crucial before selecting a methodology (Bryman, 2016; Crossan, 2003; Davison, 1998; Proctor, 1998). Proctor (1998) contends that every research endeavor requires a robust groundwork and justification, considering the study's purpose, research question, methodology, and the researcher's individual philosophy.

- **Positivism:** The positivist research ethos asserts that true knowledge can be demonstrated through scientific means, such as observation, experimentation, and logical proof. Unlike subjectivism, positivists argue that reality is constant and can be objectively observed and described without emotional bias (Bryman, 2016; Collins, 2018; Davison, 1998). Alavi & Carlson (1992), reviewing 902 information systems research articles found a unanimous adoption of a positivist stance in all empirical studies, which typically exclude the researcher and human considerations. Positivism is closely associated with the hard sciences, emphasizing a detached, objective approach (Davison, 1998; Saunders et al., 2019).

- Interpretivism: Interpretivism suggests that social scientists must possess an intuitive understanding of the subjective relevance of social activity. This approach acknowledges the need for a method that accommodates the distinctions between human experiences and natural science objects (Bryman, 2016). Collins (2018) argues that, although interpretivism opposes objectivism, it doesn't align strictly with either subjectivism or subjectivist philosophy. This challenges the perspectives of Creswell & Creswell (2018) and Crotty (1998), who assert that personal experiences uniquely shape individuals' opinions and world-views, emphasising the unique nature of each person's experience of the world.

Saunders et al. (2019) delineate diverse research philosophies, encompassing positivism, realism, interpretivism, postmodernism, and pragmatism, each influencing the orientation and emphasis of a research endeavor. Positivism underscores the demonstration of true knowledge through scientific methods, emphasizing objectivity and empirical data. Realism posits an objective reality, placing value on empirical evidence. Interpretivism accentuates subjective experiences and qualitative insights in comprehending social phenomena. Postmodernism questions objective reality, emphasizing the role of language and culture. Pragmatism centers on practical implications and real-world problem-solving.

For this study, a pragmatic research philosophy is embraced, emphasizing a preference for practical solutions to real-world issues over strict adherence to philosophical doctrines (Creswell, 2014; Hall, 2013; Shannon-Baker, 2016). Pragmatism, in the context of this study, offers flexibility in addressing the practical challenges confronting Nigerian educational institutions while striving for effective and feasible resolutions. By integrating the positivism and interpretivism paradigms, this philosophy allows the researcher to utilise both quantitative and qualitative methods to develop the Automated Student Result Management System. According to Creswell (2003), positivism reflects a deterministic philosophy linking causes to effects, providing a quantitative method framework focused on empirical data and objectivity, especially in addressing practical

challenges in educational institutions. Interpretivism, defined by Crotty (2003), seeks culturally derived and historically situated interpretations of the social life-world, enabling the exploration of subjective perspectives, human experiences, and qualitative insights (p.67). The study will engage educational authorities, secondary school administrators, and system end-users to guarantee that the system aligns with their requirements and resolves their issues.

3.2.2. Research Approach and Methodology Selection

Research methodology encompasses the fundamental principles and specific strategies utilised for collecting, processing, and interpreting data in a research inquiry (Creswell & Creswell, 2018). According to Creswell & Creswell (2018), the choice of research methodology is shaped by various factors, including the research question, the researcher's background, and the intended audience of the study. The methodology can be broadly categorised into two primary dimensions: data collection and data analysis or justification.

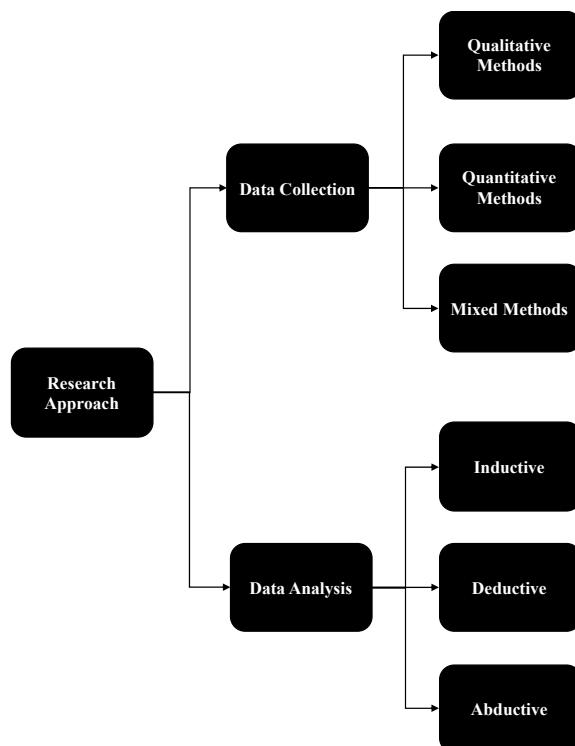


Figure 8: Components of Research Approach

3.2.2.1. Research Approach for Data Analysis

Creswell and Creswell (2018) endorse the methodological appropriateness outlined by Edmondson and McManus (2007) by delineating three approaches for establishing and formulating theoretical contributions within a research project: inductive, deductive, and abductive.

- **Inductive Approach:** Inductive research involves the examination of a phenomenon, leading to theory development based on gathered data (Saunders et al., 2019). Inductive methods focus on the context rather than cause-and-effect relationships (Collins, 2018), guiding the researcher from observation to theory (Chandra & Hareendran, 2018). The process generates hypotheses (Bryman, 2016), and as per Chandra and Hareendran (2018), inductive methods are presumptive, with conclusions being speculative and not always precise.
- **Deductive Approach:** The deductive method commences with a theoretical hypothesis, subjecting it to examination through a pre-defined research strategy. It involves constructing a theory and then testing it through assertions (Saunders et al., 2019). Starting with a broad perspective (theory), the researcher formulates testable hypotheses (Chandra & Hareendran, 2018; Sachdeva, 2008). Deductive inferences, according to Chandra & Hareendran (2018), are considered valid.
- **Abductive Approach:** Abductive inquiry integrates both inductive and deductive reasoning, bridging the gap between facts and theory (Saunders et al., 2019). It alternates between inductive and exploratory investigation and testing hypotheses through deductive reasoning (Dubois & Gadde, 2002).

This research embraces a philosophy that places importance on gathering and analysing data to acquire knowledge, especially within the realm of business research, where a significant portion of information holds practical relevance (Bell et al., 2019). The chosen research approach is abductive, which is commonly known as exploratory research. The abductive research approach

provides a comprehensive examination of practical issues with a problem-solving focus (Lukka & Modell, 2010). Peirce (1878) emphasized that the abductive approach involves formulating and testing hypotheses based on observations and data, making it well-suited for exploring and uncovering new ideas in this context. This method integrates quantitative analysis, utilising historical student result data, and qualitative research through case study interviews with educators and administrators. Through the amalgamation of empirical findings and theoretical insights, the objective of this study is to bring about a transformation in result management practices within secondary schools within the Nigerian educational sector.

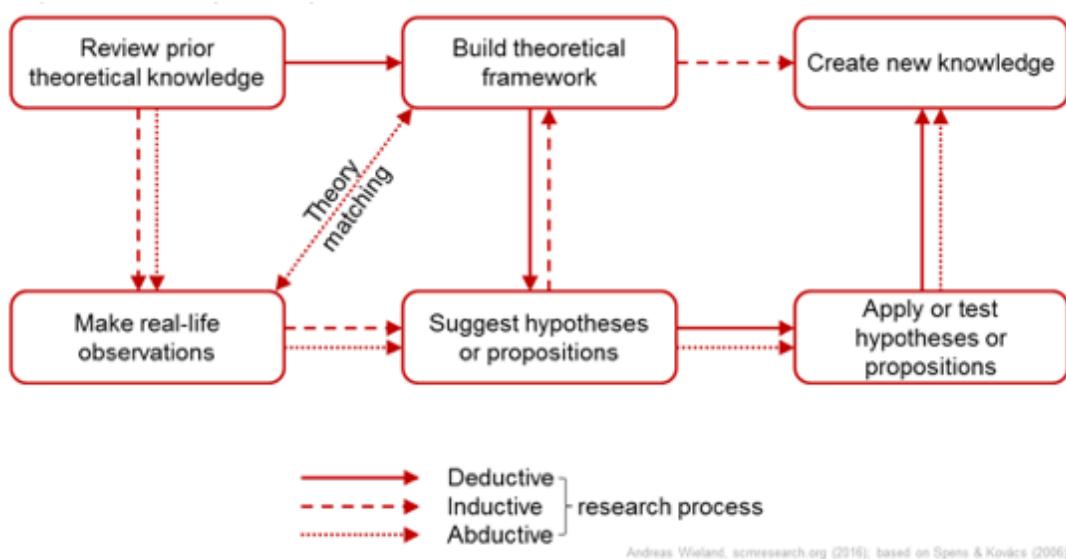


Figure 9: Deductive, Inductive and Abductive Research (Source: Adapted from Spens & Kovács, 2006).

3.2.3. Research Methodology (Research Approach for Data Collection)

The choice of a research method has a substantial impact on the overall research process (Collins, 2018), particularly in the context of developing an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector. Edmondson and McManus (2007) emphasise the importance of a research method aligning or "fitting" with the study topic, existing research, research design, and theoretical contributions to ensure its effectiveness. Referred to as methodological fit, this concept holds significance throughout the research process, from its early stages to maturity (Edmondson & McManus, 2007). Figure 3.4 (below) provides a visualisation

of the categorisation of research methods based on qualitative, quantitative, and mixed data collection methodologies.

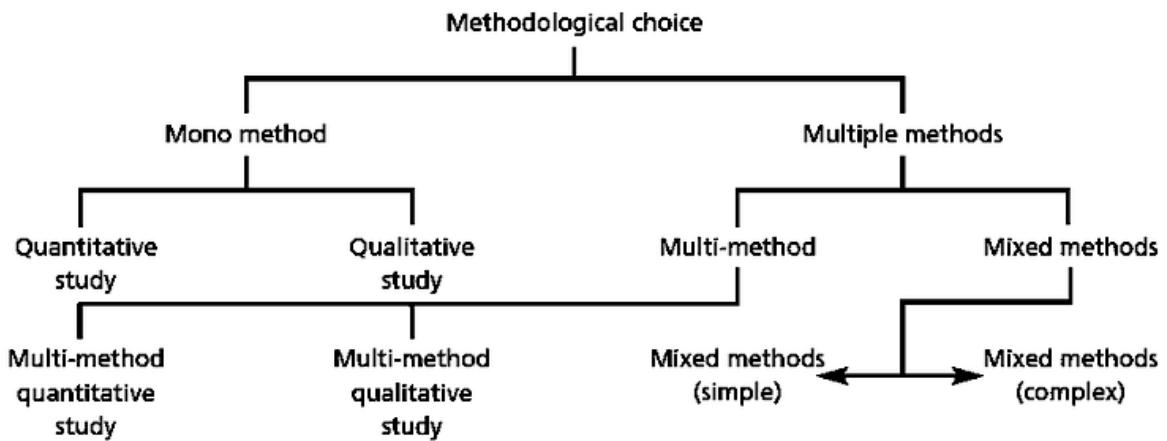


Figure 10: Research Methodological Choice (adapted from Saunders et al., 2016, p. 166)

Saunders et al. (2019) identified three main types of research methods, namely: quantitative, qualitative, and mixed methods.

- Quantitative research involves the collection, analysis, and interpretation of numerical data (Kothari, 2004). It utilizes quantitative methods to describe, predict, or control factors, often aiming to validate or invalidate hypotheses by exploring relationships between numerically measured variables using statistical and graphical techniques (Saunders et al., 2019).
- Qualitative research entails the gathering, analysis, and interpretation of nonnumerical data, such as text, images, audio recordings, and video clips (Saunders et al., 2019). This method aims to comprehend subjective perceptions and understandings of social reality and often takes an interpretive approach, examining phenomena through the viewpoints of participants (Ritchie et al., 2013). Typically conducted in naturalistic settings, qualitative research seeks to grasp the social reality experienced by individuals, groups, or cultures from the participants' perspectives in their native environments (Bryman, 2016).

- Mixed methods research integrates both qualitative and quantitative data and may encompass various approaches influenced by philosophical and theoretical frameworks (Creswell & Clark, 2017). Guided by philosophical principles, mixed methods research combines qualitative and quantitative methodologies in data collection and interpretation (Saunders et al., 2019).

A mixed-methods approach will be employed to conduct a holistic examination of the research topic (Doyle et al., 2019). The quantitative phase involves analysing historical student result data to validate the effectiveness of the Student Result Management System. Simultaneously, the qualitative phase includes interviews and focus groups with stakeholders at Anchor Heights School to gain insights into specific challenges and expectations. As emphasised by Noble & Heale (2019, p. 1), the triangulation of quantitative and qualitative findings ensures a well-rounded investigation. Quantitative research will involve the collection and analysis of numerical data related to historical student results, system performance, and user interactions. Surveys and questionnaires may be used to gather quantitative data. Qualitative research methods, such as interviews and focus groups, will be employed to gain in-depth insights into the challenges faced by educators, administrators, and students in result management. These qualitative insights are essential for understanding user needs and expectations.

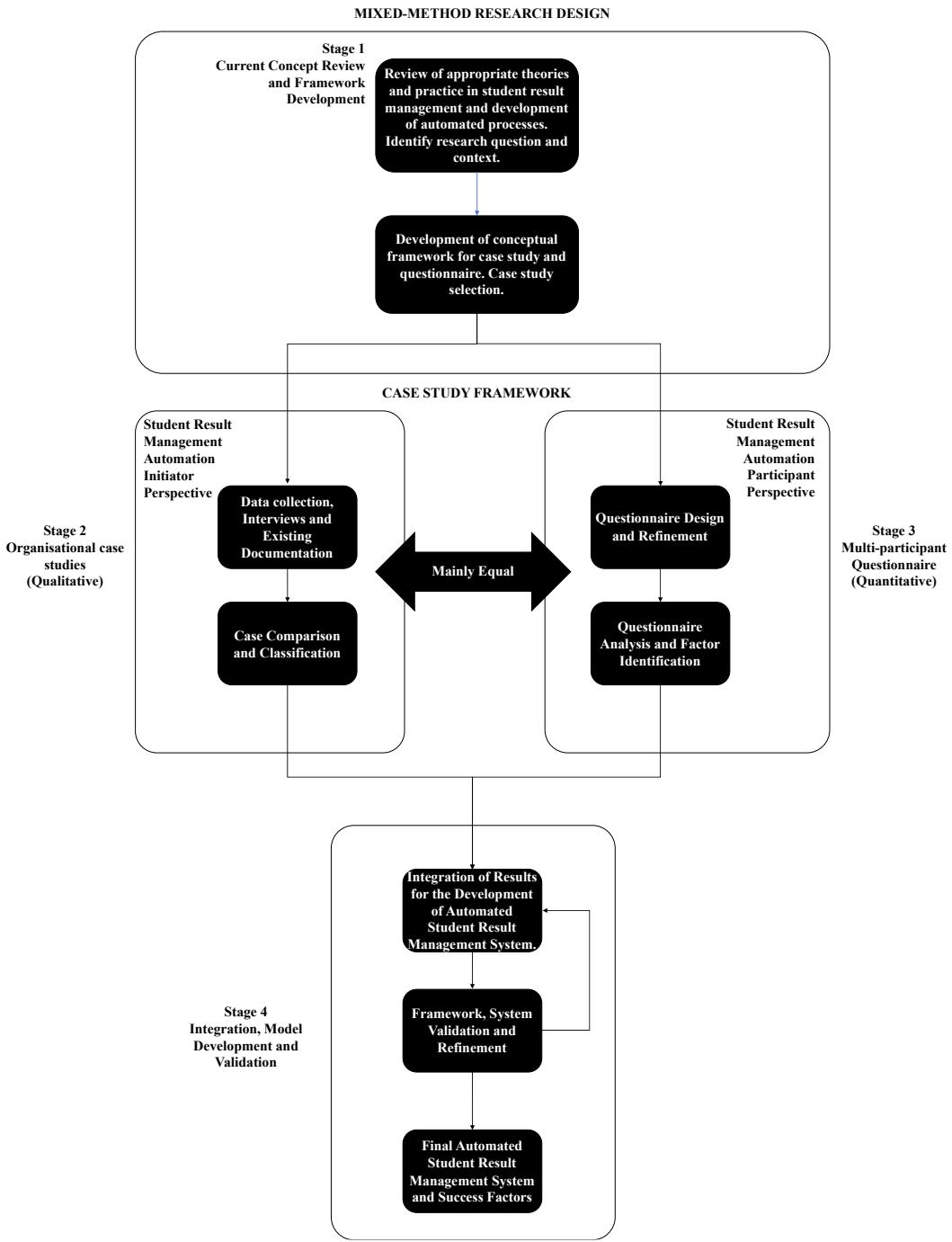


Figure 11: Mixed method research design approach (Adopted from McDougall et al., 2007).

3.2.4. Research Strategy

A research strategy serves as a blueprint for addressing the research topic, connecting research philosophy to data collection and analysis methods (Saunders et al., 2019). It encompasses the overall research approach (Bell et al., 2019). Following the identification of various tactics, such

as positivist approaches like experiments, surveys, and case studies, and anti-positivist approaches like case studies, ethnography, and archival research, the research assesses and supports the most relevant strategies (Creswell & Creswell, 2018; Davison, 1998; Saunders et al., 2019). The final section discusses the impact of the chosen methodology.

- **Experiment:** An experiment examines whether a change in one independent variable influences another dependent variable (Saunders et al., 2019). It involves testing a theory through a scientific and controlled study approach, often conducted in a laboratory setting. Deductive research is employed to test hypotheses, and positivist research believes that knowledge can be explored objectively without considering context or culture (Saunders et al., 2019). However, due to the controlled experimental environment, the techniques may have limitations in identifying real-world connections (Galliers & Dorothy, 2003). It focuses on hypotheses rather than research questions.
- **Case Study:** A case study involves a detailed examination of a person, group, organization, event, phenomenon, or topic, aiming to understand real-world problems faced by people (Saunders et al., 2019). Case studies can be either positivist or interpretivist, depending on the research approach, data collection, and analysis methods (Davison, 1998). However, drawing broad conclusions can be challenging, as case studies often focus on a single entity, and biases may arise from different interpretations of the same data (Davison, 1998).
- **Ethnography:** Ethnography employs a participatory and collaborative methodology, seeking long-lasting solutions to real-world challenges faced by organisations (Davison, 1998; Saunders et al., 2019). Researchers' engagement with issues is motivated by a desire for real-world impacts, often with liberatory intent, while simultaneously reinforcing accepted theories in the field. Ethical considerations are crucial, especially when the researcher might be directly involved (Davison, 1998; Saunders et al., 2019).
- **Survey:** Survey research employs a cross-sectional design, collecting data mainly through questionnaires or structured interviews at a single point in time to gather quantitative or

quantifiable data about multiple variables (usually several), which are then analyzed to identify patterns of association (Bryman, 2016; Saunders et al., 2019). Davison (1998) notes the challenge of determining causation or events' leading factors.

- **Action Research:** Action research, similar to ethnography, adopts a participatory and collaborative methodology, aiming to find enduring solutions to real-world challenges in organizations. Researchers engage directly with issues, aspiring to have real-world impacts and contribute to established theories in the field, necessitating a focus on ethics (Davison, 1998; Saunders et al., 2019).
- **Grounded Theory:** Grounded theory, as with action research and ethnography, employs a participatory and collaborative methodology to address real-world challenges in organizations. The researcher's engagement is driven by a desire for enduring, real-world impacts and contributing to established theories, requiring careful consideration of ethical aspects (Davison, 1998; Saunders et al., 2019).
- **Phenomenology:** Similar to action research, ethnography, and grounded theory, phenomenology utilises a participatory and collaborative methodology to find lasting solutions to real-world challenges in organizations. The researcher's involvement is motivated by a desire for tangible, real-world impacts and the reinforcement of accepted theories, demanding a strong ethical focus (Davison, 1998; Saunders et al., 2019).

The chosen research strategy for this study is the case study approach, with a primary focus on Anchor Heights School as the central case. Priya (2021, p. 95) argues that employing a case study methodology provides valuable insights into the viability and advantages of a research endeavor, addresses existing research gaps, and contributes significantly to knowledge. In this context, the case study approach facilitates a comprehensive examination of the challenges and the practical implementation of the Automated Student Result Management System within a genuine educational setting. This targeted strategy is designed to align with the specific requirements of

educational institutions, aiming to substantiate the system's efficacy and promote innovative practices in result management within the Nigerian education sector.

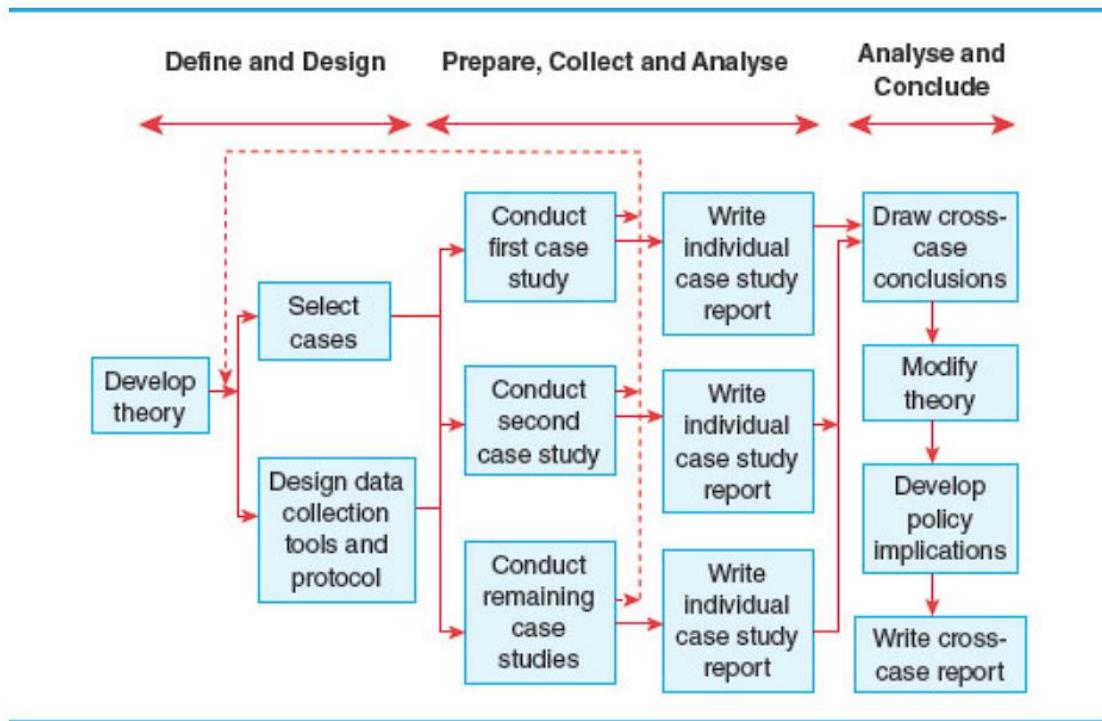


Figure 12: Overview of the case study research strategy (adapted from Yin, 2009)

3.2.5. Sampling Strategy

Sampling is a crucial element in research design, allowing the selection of a subset that mirrors the larger population (Bowen, 2009, p.37). This technique enables researchers to infer about the entire population without the need for exhaustive research on each individual (Saunders et al., 2019). Saunders et al. (2019) emphasize that choosing the right sampling approach is crucial for research studies, ensuring the representation of the target population and enhancing the relevance of the findings.

Purposive sampling was employed in the research to ensure participants with expertise in the implementation of technology in secondary education were consulted, enhancing the study's ability to gather valuable insights from individuals well-versed in the subject matter (Bryman, 2016; Saunders et al., 2019).

3.2.5.1. Rationale for Stratified Sampling

The participants in this research were deliberately chosen based on their expertise and insights into the development and implementation of the Automated Student Result Management System (ASRMS) in secondary schools in the Nigerian Education Sector. The decision to employ purposive sampling is rooted in its effectiveness in deliberately selecting participants with specific expertise and roles relevant to the application of technology in Nigerian secondary schools. Additionally, participants were selected for their willingness to contribute thoughtfully to the study, ensuring a comprehensive exploration of the subject matter. The following criteria guided participant selection:

- Participants needed to be experienced professionals in the education sector, particularly in secondary schools.
- They were required to work and reside in Nigeria.
- Familiarity with the educational regulatory framework in Nigeria was essential.
- Knowledge about student result management processes and the challenges associated with manual systems.
- Optional familiarity with IT trends in the education sector.

This purposive sampling approach ensures targeted representation from key stakeholders involved in the system's development and usage, allowing for a concentrated exploration of perspectives crucial to the study's objectives.

3.3. Data Collection Methods

Data collection is crucial, as the methodology and analytical approach employed by the researcher shape how the gathered information is utilised and the explanations it can yield (Teherani et al., 2015; Wright et al., 2016). Primary data collection gathers firsthand information from participants through observation, interviews, or questionnaires, while secondary data involves reviewing and

interpreting textual data extracted from diverse documents (Bowen, 2009, p.30). For this research, data gathering techniques will involve multiple sources and methods:

- **Historical Student Result Data:** Historical student result data will be obtained from Anchor Heights School's records. This dataset will serve as the foundational information for the building of the Automated Student Result Management System and will also be crucial for validation.
- **Surveys and Questionnaires:** Surveys and questionnaires will be employed to gather quantitative data, focusing on user preferences, expectations, and satisfaction levels related to the Automated Student Result Management System. The decision to use a Google forms for stakeholder information collection was motivated by its user-friendly interface and the minimal technical expertise required. The questionnaire, featuring a mix of open-ended and closed-ended questions, will be distributed through social media platforms. Responses will be collected in real-time and automatically organised into a spreadsheet, offering structured and numerical insights.
- **Interviews:** Qualitative data collection process will involve semi-structured open-ended interviews, according to Yin, 2018, with secondary school administrators. This technique allows the researcher to gather additional information and seek clarification using open-ended questioning (Barriball & While, 1994; Yin, 2018). The interviews will center on the administrators' personal experiences, challenges, and recommendations concerning student result management, aiming to extract in-depth, narrative insights into their perspectives.
- **Empirical Research:** After developing and implementing the automated system, collect empirical data to evaluate its impact on administrative efficiency, academic experiences, and educational progress. This can involve analysing system usage data, academic performance data, and feedback from users.

By integrating historical student result data, conducting interviews, administering surveys, and conducting empirical research, the researcher can effectively tackle the research objectives. This

approach enables a thorough understanding of the research topic while ensuring alignment with user expectations and the requirements of the automated student result management system.

Table 2: Comparison of Proposed Data Gathering Techniques (Source: Akintunde, 2023)

#	Data Gathering Technique	Prompt Gathering of Data	Ease of Collection of Information	Time Consuming	Bias	Limited Data Depth
1	Historical Student Result Data	Yes	Yes	No	No	No
2	Surveys and Questionnaires	Yes	Yes	Yes	Yes	No
3	Interviews	No	No	Yes	Yes	Yes
4	Empirical Research	Yes	No	Yes	No	No

The data collection process was executed with careful attention to confidentiality, adhering strictly to all established guidelines of the University. To ensure ethical practices and data security, the collected data was stored exclusively on the authorized University OneDrive storage location throughout the entire project. The essential ethical considerations and risk register for this study were duly completed. It is important to highlight that the gathered data was solely employed for the project's purposes and promptly deleted upon the project's conclusion.

3.3.1. Collected Dataset

The dataset collected from Anchor Heights School will be a dataset from September 2021-September 2023. Data cleaning will be done using Microsoft Excel, and duplicated data will be deleted, missing values and irrelevant columns will also be deleted.

3.4. Data Analysis

This study adopted a case study research strategy and employed abductive thematic analysis as the data analysis technique, aiming to identify recurrent themes within qualitative data (Braun & Clarke, 2006; Willig, 2017). The research question guided the categorisation and evaluation of data derived from participant responses (Smith, 2015). Data analysis will encompass both quantitative and qualitative methods:

3.4.1. Quantitative Data Analysis

For the analysis of numerical data collected through surveys and questionnaires, we will employ statistical analysis methods. This includes:

- Data Visualisation: Utilise data visualization tools such as bar charts, histograms, pie charts, scatter plots and box plots to represent quantitative data graphically. Visualizations make it easier to interpret and communicate survey results effectively (Healey, 2019).

3.4.2. Qualitative Data Analysis

To analyse qualitative data obtained from interviews and focus groups, we utilized the following methods:

- Thematic Analysis: Thematic analysis will help in identifying recurring themes and patterns within participants' responses. By coding and categorizing qualitative data, we aim to uncover common challenges and expectations related to result management (Braun & Clarke, 2006). Steps taken for the thematic analysis include:
 - Data Transcription: Each interview was transcribed by listening to each recording and typing the content into a Microsoft Word document. After verification with the participants, the researcher immersed themselves in the data, highlighting key words, sentences, or paragraphs.
 - Analysis of Highlighted Content: Analysing these phrases involved reviewing the research question for relevance. Some participant-provided information, while interesting, was excluded if not pertinent to the study's objectives.
 - In-depth Data Analysis: Participant-provided data underwent thorough examination to identify the scope and nature of each theme. The transcribed material was analysed and coded using NVivo 12 Plus in the context of developing an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector.

This combined quantitative and qualitative data analysis approach will provide a comprehensive understanding of user preferences, challenges, and expectations regarding the Student Result Management System. It will help us identify both numerical trends and qualitative insights to inform the development and implementation of the system.

3.5. Research Ethics

In this study, ethical guidelines were strictly followed to ensure the protection of participants' well-being, privacy, and rights, upholding the overall integrity of the research process (Sheffield Hallam University, 2022). All discussions were based on secondary and primary sources, and no personal experiences were utilized. To comply with the Belmont Report guidelines, participants were provided with a participant information sheet (see Appendix F) and an interview consent form (see Appendix G). They were asked to read the participant information sheet and fill out the consent form willingly, freely, carefully, and clearly.

3.5.1. Ethics of Data Collection

In conducting this study, strict adherence to ethical guidelines was maintained to ensure the protection of participants' well-being, privacy, and rights, thereby upholding the overall integrity of the research process. The key ethical principles observed include:

Table 3: Proposed Ethics of Data Collection

#	Ethical Principles	Description
1	Informed Consent	Prior to data collection, all participants, including the school authority and students, were thoroughly informed about the purpose and nature of the study. Explicit consent was obtained from each participant, ensuring voluntary participation.
2	Privacy and Confidentiality	Robust measures were implemented to safeguard the privacy of individuals. Collected data was stored securely, and access was restricted to authorized personnel only. Participants were assured

		that their information would remain confidential and anonymized during analysis.
3	Data Security and Integrity	Throughout the data collection process, secure storage and transmission practices were employed to prevent breaches. Data integrity was maintained, ensuring the accuracy and reliability of the information gathered.
4	Respect for Participants' Rights	Participants' rights, including those of educational institutions, administrators, teachers, and students, were acknowledged and respected. Voluntary participation was emphasized, and participants were assured of the right to withdraw at any stage without consequence.
5	Transparency and Full Disclosure	Participants were provided with transparent and complete information about the research objectives, methods, and potential impacts before and during data collection. Any conflicts of interest were disclosed, and openness was maintained throughout the research process.
6	Accountability and Integrity	The research team took responsibility for the ethical conduct of the study, upholding the highest standards of integrity, honesty, and professionalism during data collection.
7	Compliance with Regulations	The research adhered to all relevant laws, regulations, and guidelines governing data collection and research activities in the Nigerian education sector. Ethical standards set by regulatory bodies were strictly followed.

3.6. Summary of Chapter

In this research, a comprehensive methodology was designed to address the challenges and requirements of automating result management in Nigerian secondary education. A pragmatic research philosophy was adopted, integrating positivism and interpretivism, with a focus on practical solutions. The abductive research approach was chosen, allowing exploration and testing of hypotheses through both quantitative and qualitative methods. The case study strategy, centered on Anchor Group of Schools, was employed, offering valuable insights and promoting real-world impact. Purposive sampling ensured the selection of participants with specific expertise in technology implementation in education. Data collection involved historical student result data, surveys, interviews, and empirical research. Ethical considerations were diligently followed, with measures in place for informed consent, privacy, confidentiality, data security, and participant rights. Data analysis included quantitative methods such as visualization and qualitative methods like thematic analysis. The integration of both approaches aimed to provide a holistic understanding of user preferences and challenges related to the Automated Student Result Management System. The study's ethical principles included transparency, accountability, and compliance with regulations. Overall, the methodology was meticulously crafted to ensure a robust and ethical research process.

Chapter Four

Research Findings and Data Analysis

4.0. Introduction

In this pivotal chapter, we traverse the transition from theoretical underpinnings to practical study in the context of our research endeavor which is building an Automated Student Result Management System (ASRMS) for Secondary Schools within the Nigerian Education Sector. The study embarks on a qualitative, exploratory, and semi-structured interview-based approach to delve into the intricate process of data collection, shedding light on the theoretical framework's practical implementation. The primary focus is on understanding how information technologies and business process automation can optimize student result management. Insights gained from these interviews offer valuable perspectives on the potential impact of automated processes, unveiling pathways to enhance efficiency and efficacy in the education sector.

This chapter not only presents the acquired data, demographic details of participants, and results of the study but also initiates a thoughtful analysis of the findings, providing a crucial linkage between research objectives and the forthcoming meaningful conclusions. Furthermore, a discussion of the pilot study and an exploration of emerging themes in response to interview questions enrich the narrative, setting the stage for a comprehensive exploration of the automated student result management system's implications.

4.1. Planning Process for Automated Student Result Management System

During the initial phases of research planning, we meticulously charted the project's course by crafting a comprehensive Project plan and Gantt Chart. Gerald and Lechter (2012) highlighted that the Gantt Chart primarily centers on optimising resource utilization and bolstering productivity. These strategic

documents served as a roadmap, delineating tasks and resource requirements, ensuring a systematic and timely accomplishment of the project's objectives.

The subsequent phase involved comprehensive data collection and analysis for the proposed Automated Student Result Management System. Utilising a combination of interviews and online questionnaires (Harris & Brown, 2019), stakeholders' perspectives were sought to identify opportunities for automation, aiming to enhance result visibility and streamline academic operations. This dual-method approach facilitated a holistic exploration of stakeholder viewpoints, contributing to a nuanced understanding of the research subject.

The data collection initiative commenced with the creation of a structured questionnaire designed to extract quantitative insights from a diverse participant pool, including teachers, students, and administrators directly involved in or impacted by the result management system. The questionnaire, strategically crafted to address key research objectives, delved into themes such as Automation of Result Processing, Improved Data Management, Ease of Record Keeping, and Enhanced Student Academic Performance.

Informed by the collected data, both functional and non-functional requirements were identified for the proposed system. Functional requisites encompassed features such as user registration/login, result publication, grade management, and communication tools. Simultaneously, non-functional aspects, including system availability, data confidentiality, integrity, security, and compatibility, were outlined to ensure a robust and secure system. To discern user preferences and prioritise system features, the Kano Model was employed.

This comprehensive approach to planning ensured that the project was well-informed, addressing both the technical and user-oriented aspects of the Automated Student Result Management System development.

4.2. Influence of the UTAUT Theoretical Framework on Research Analysis

In this study, the Unified Theory of Acceptance and Use of Technology (UTAUT) was employed as its theoretical framework. The UTAUT provided a structured foundation for analysing research data and understanding the factors influencing the acceptance and utilisation of the Automated Student Result Management System (ASRMS).

Guided by the UTAUT, this study identified and examined key factors impacting the adoption and use of the ASRMS, drawing on conceptual and empirical constructs. These constructs included performance expectancy (the belief in the system's ability to enhance academic processes), effort expectancy (the perception of ease in using the ASRMS), and social influence (the influence of others in encouraging or discouraging system use). The empirical constructs encompassed demographic factors such as gender, age, experience, and the voluntariness of system use, reflecting the UTAUT's assertion that these variables can significantly affect technology acceptance.

Through this comprehensive framework, the researcher gained insights into the factors driving the acceptance and utilisation of the ASRMS in the context of secondary schools in Nigeria. The analysis focused on understanding the impact of the ASRMS on educational outcomes, administrative efficiency, and the overall educational landscape. Additionally, the UTAUT facilitated the identification of areas for improvement in the design and implementation of the ASRMS, ensuring that the system aligns with the specific needs and dynamics of the Nigerian education sector.

4.3. Background of Participants

This section provides an overview of the backgrounds of the two individuals interviewed for the study. To uphold a formal methodology and ensure data reliability, authenticity, and eligibility, only the professional backgrounds of these individuals are disclosed, withholding their names and specific details of the school. Demographic information gathered from the participants includes their level of education, years of experience in the relevant educational field, location or region, and gender. Both participants met the specified requirements outlined for inclusion in the study. The selection criteria for participants were as follows:

- Participants had to hold positions as key stakeholders in the educational sector, with roles as the Principal and the Data Entry Officer of a secondary school.
- Participants must be currently working and located in Nigeria.
- Familiarity with educational regulations and trends in Nigeria was a prerequisite.
- Knowledge about academic record management and educational IT trends was preferred.

Both the Principal and the Data Entry Officer expressed interest in participating, signed necessary consent forms, and were available for interviews within the designated time frame for the research project. They met the inclusion criteria and brought valuable perspectives to the study, drawing from their roles and experiences within the secondary school environment.

Table 4: Demography of Participants

Reference ID	Position	Years of Experience	Gender	Location in Nigeria
PRT-ASRMS1	Principal	12	M	Lagos
PRT-ASRMS2	Data Entry Officer	8	F	Lagos

Participant 1 – PRT-ASRMS1

The participant is a seasoned educator with over 12 years of experience in the Nigerian education sector, specifically focused on secondary schools. He holds the position of Principal in the current school used as case study and is based in Lagos. His expertise includes curriculum development, student management, and educational leadership. He has been involved in various projects related to the implementation of technology in education, including the establishment of an online educational classes for secondary schools in Lagos state, Nigeria.

During his tenure, he intends to successfully oversee the integration of ASRMS, ensuring efficient and accurate result management for students. His role involves coordinating with teachers, staff, and IT professionals to streamline the process of recording, analysing, and disseminating student results. Additionally, he will actively engage in training sessions for teachers and staff to enhance their proficiency in utilising the ASRMS.

Participant 2 – PRT-ASRMS2

The participant, serving as the Data Entry Officer in the current school under consideration for the ASRMS project, brings 8 years of valuable experience to the initiative. Based in Lagos and identified as female, she holds a pivotal role in data entry and management within the system. Her expertise lies in meticulous and accurate management and organisation of student result data, ensuring the integrity and reliability of all student information.

With a keen eye for detail and a thorough understanding of data management principles, she will contribute significantly to the seamless functioning of the system. Her expertise will be instrumental in maintaining high standards of data accuracy and reliability, aligning with the overall goal of the ASRMS project to enhance result management in secondary schools.

4.4. Research Data Analysis Methodology

The effectiveness for uncovering patterns or themes in qualitative data is demonstrated by thematic analysis (Maguire & Delahunt, 2017). Braun & Clarke (2006) recommend thematic analysis as a fundamental and versatile qualitative method (p.78). This method involves linking identified themes to the subject of inquiry and comprehending them semantically (Braun & Clarke, 2006).

In this research context, interviews were transcribed based on recorded sessions rather than performed in real-time. Despite the availability of transcription software, a deliberate choice was made in favor of hand transcription for its time-consuming yet accurate nature. Hand transcription allowed the researcher to revisit the data, gaining a deeper understanding and laying a solid foundation for a smoother coding process, crucial in the thematic investigation with only two participants.

The research findings were translated into four empirical considerations for how the ASRMS might benefit secondary schools (see Table 4.2). Further subject reviews included breaking down the interview transcripts into hidden themes, and identifying commonalities. Induction was crucial to transforming these facts into a comprehensive framework based on themes discovered in the interview transcripts and gathered data.

The results from this inductive thematic analysis laid the foundation for the analytical report. Emphasis was placed on key aspects of each issue, and insightful ideas were documented. With the synthesis of texts complete, the study outcomes were evaluated, and the acquired knowledge was integrated into the research's conclusions within the scope of building an Automated Student Result Management System for secondary schools in the Nigerian Education Sector.

4.5. Data Presentation and Analysis of Result

The presentation of data plays a pivotal role in conveying the research outcomes within the context of developing an Automated Student Result Management System (ASRMS) for secondary schools in the

Nigerian education sector. This presentation serves as a canvas upon which the researcher vividly portrays the findings of the ASRMS project. Meticulously designed tables, charts, graphs, and figures are utilized to expose the essence of data-driven discoveries, each visual element telling a story and contributing to a comprehensive understanding of the complexities underlying the research objectives.

4.5.1. Preliminary Interviews

The research commenced with two preliminary interviews involving stakeholders within the educational sector, with specifics on Anchor Heights School. These interviews aimed to validate the proposed questions for the primary research inquiry, ensuring their relevance and effectiveness. The feedback from the preliminary interviews affirmed that the questions were appropriate for the main study. Participants expressed ease in sharing insights, opinions, and experiences, indicating the suitability of the data collection approach.

4.5.2. Identification of Key Themes

Table 4.2 presents the four primary themes derived from the two semi-structured interviews, outlining the evolving themes, the number of contributors, and the overall theme frequency. Figure 4.1 illustrates the thematic framework generated from the interviews.

Table 5: Key Themes

#	Themes	Participants
1	Efficiency and Accuracy	2
2	User Accessibility	2
3	Enhanced Educational Processes	2
4	Data Security and Privacy	2

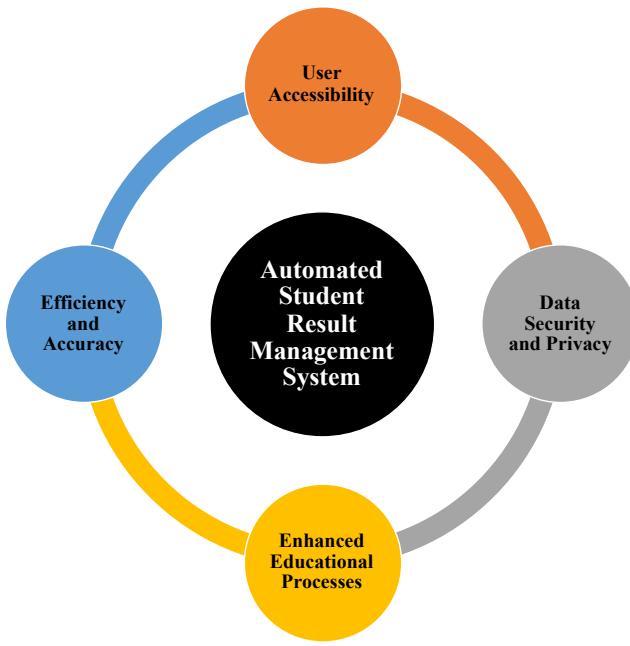


Figure 13: Thematic Framework

The identified themes reflect a comprehensive understanding of the research focus, shedding light on the potential impact of implementing an Automated Student Result Management System (ASRMS) in Nigerian secondary schools. The thematic analysis offers valuable insights into how automation can enhance result management, benefiting both students and educational institutions.

4.5.2.1. Theme 1 - Efficiency and Accuracy: Synthesis

The unanimous agreement among participants emphasizes that an Automated Student Result Management System (ASRMS) plays a pivotal role in enhancing efficiency and accuracy in processing student results. Automation, according to all contributors, significantly reduces turnaround time (TAT) and addresses challenges associated with manual data collection and input.

Both perspectives, represented by PRT-ASRMS1 and PRT-ASRMS2, converge on key themes:

Turnaround Time Reduction: Participants collectively recognize the ASRMS's ability to drastically reduce TAT, allowing educational institutions to efficiently handle increased result processing tasks without the need for additional resources.

Elimination of Errors: Automation is seen as a solution to eliminate inconsistencies and delays linked to manual processes, emphasizing the system's role in minimizing errors in result calculations and data entry.

Efficiency Enhancement: PRT-ASRMS1 highlights the transformative potential of the ASRMS, anticipating improvements in academic performance and streamlined administrative processes. PRT-ASRMS2 focuses on addressing challenges in the current manual data entry process, emphasizing the need for solutions to enhance efficiency.

Both viewpoints stress the importance of features such as automated result calculations, data validation checks, and intuitive interfaces to streamline workflows. PRT-ASRMS1 underscores the need for user-focused design, prioritising information processing capabilities, speed, ease of use, and accuracy.

In summary, the shared perspectives emphasise that the ASRMS not only reduces time and errors in academic result processing but also has transformative potential, aligning with modern educational practices to bring about enhanced efficiency and accuracy.

4.5.2.2. Theme 2 - User Accessibility: Synthesis

The discussions on the Automated Student Result Management System (ASRMS) highlighted user accessibility as a critical theme, emphasising its transformative impact on educational institutions. Both PRT-ASRMS1 and PRT-ASRMS2 concurred on the system's potential to enhance efficiency, generate revenue, and improve the overall user experience.

PRT-ASRMS1 viewed the ASRMS as a game-changer, anticipating benefits such as improved efficiency, reduced teacher workload, and heightened accuracy in result calculations. The emphasis was on the transformative role of the system, positioning it beyond mere task simplification to a fundamental shift in operational paradigms. Interface design priorities included user-friendliness and accessibility, aligning with institutional goals.

PRT-ASRMS2 underscored the financial benefits, emphasizing cost savings through the elimination of manual data entry. Key features for user accessibility included automated result calculations, data validation checks, and intuitive interfaces for data entry officers. Ongoing support and training strategies were highlighted to ensure successful adaptation, recognising the diverse skill levels among users.

In conclusion, both participants highlighted the foundational role of user accessibility in the ASRMS implementation. The system's potential to streamline processes, reduce manual efforts, and enhance efficiency emerged as a consistent theme, emphasising the need for careful alignment with institutional goals and user-friendly design to maximise benefits.

4.5.2.3. Theme 3 - Enhanced Educational Processes Through ASRMS: A Synthesis

The Enhanced Educational Processes value of an Automated Student Result Management System (ASRMS) takes center stage in the perspectives of both participants, PRT-ASRMS2 and PRT-ASRMS1.

PRT-ASRMS2 Perspective

- Fundamental Improvement: PRT-ASRMS2 views the ASRMS as a fundamental improvement in result management processes, extending beyond efficiency gains. The automation of calculations, validation checks, and user-friendly interfaces is seen as pivotal for enhancing workflow efficiency.

- **Insightful Analysis:** The system's ability to assist data entry officers and extract meaningful insights from performance data is emphasized. Leveraging reporting capabilities for trend identification is seen as valuable for continuous improvement in the educational setting.

PRT-ASRMS1 Perspective

- **Transformative Benefits:** Mr. Kunle, the Principal, anticipates transformative benefits through the ASRMS, envisioning significant improvements in academic performance, administrative processes, and overall efficiency. The focus is on transforming how the educational institution operates.
- **Dynamic Educational Environment:** The ASRMS is seen not just as a simplification tool but as a transformative tool fostering a dynamic and responsive educational landscape. The emphasis is on streamlining processes and reducing manual efforts.

Both perspectives converge on the ASRMS's potential to significantly enhance overall educational progress by streamlining workflows, enabling insightful analysis, and fostering a dynamic educational environment.

Overall, the consensus revolves around the Enhanced Educational Processes value of the ASRMS, with a shared focus on its transformative potential in creating a dynamic and responsive educational environment. The emphasis is on the system's role in bringing fundamental improvements to educational processes.

4.5.2.4. Theme 4 – Data Security and Privacy in the ASRMS: A Synthesis

In the realm of Automated Student Result Management Systems (ASRMS), the significance of Data Security and Privacy is underscored by key insights from interviews with participant 1 (PRT-ASRMS1), and participant 2 (PRT-ASRMS2).

Perspective of participant 1 (PRT-ASRMS1):

- Robust Security Measures: Mr. Kunle emphasizes the necessity for robust security measures in an ASRMS, including advanced encryption techniques, stringent access controls, and periodic security audits. He underscores the role of cybersecurity measures in instilling trust among stakeholders and fostering a secure environment for managing sensitive student data.
- Virtual Fortress: The Principal metaphorically describes the ASRMS as a "virtual fortress" where each student's information is shielded, promoting confidentiality and reinforcing the integrity of the educational process.

Perspective of participant 2 (PRT-ASRMS2):

- Robust Encryption Protocols: The Data Entry Officer stresses the importance of implementing robust encryption protocols, access controls, and regular security audits to safeguard student data within the ASRMS.
- Security Concerns: The officer highlights the need for constant vigilance, regular training on data security practices, and immediate response to identified threats. An incident of a security breach underscores the urgency for a more secure result management system.

The participants unanimously agree on the potential of an ASRMS to streamline the student result management process while prioritising security. The system's capability to enable students to submit academic information securely from any location with internet access is highlighted, ensuring a user-friendly experience. Integrating robust security measures not only improves customer satisfaction but also instills confidence in the security of academic data processes, ultimately contributing to a positive user experience.

4.6. Data Cleaning and Questionnaire Analysis: Ensuring Pristine Input

In the context of developing an Automated Student Result Management System (ASRMS), the foundation for well-informed decision-making lies in the meticulous handling of raw data. The dataset utilised in the ASRMS development spans two years, encompassing results for junior and senior secondary schools across three terms. This raw data, presented in its unprocessed and unedited form, represents a complex amalgamation of numbers and text, serving as the initial stage of the ASRMS development process.

The objective of this section is to emphasise the pivotal role of data cleaning in the preparation of pristine input for the ASRMS. The initial dataset, originating from the archive of Anchor Heights School, showcases the transition from manual data recording in Excel format to the envisioned automated system. The raw data, before cleaning, formatting, or transformation, symbolises the starting point for subsequent integration into the ASRMS.

Bowen (2009, p.32) underscores the need for skillful interpretation to reveal inherent insights within such raw data. Furthermore, Wickham (2016) opined that data analysis is a systematic procedure involving thorough examination, refinement, transformation, and interpretation of data. As such, the primary focus is to ensure that the data is ready for input into the ASRMS without necessitating complex analysis. Employing various techniques, tools, and methodologies, this methodical approach contributes to a comprehensive understanding of the educational phenomenon under study. Ultimately, the emphasis on data cleaning aligns with the goal of ensuring that the input into the ASRMS is pristine, accurate, and ready for streamlined automated processes.

4.6.1. Data Cleaning Process - ASRMS Dataset

Data cleaning was done on the ASRMS dataset through accessible tools such as Microsoft Excel, not requiring sophisticated analysis. The cleaned dataset adheres to the principles outlined by Jagadish et

al. (2014), focusing on thorough preprocessing and quality control measures. This step becomes crucial in addressing errors, inconsistencies, and missing values inherent in raw marks obtained from continuous assessment tests and exams.

Key aspects of cleaning the ASRMS dataset include:

- **Error Removal:** Correcting errors introduced during data entry or collection, encompassing typographical errors, numerical inaccuracies, and mislabeling of categories.
- **Consistency:** Ensuring uniformity across different entries and variables. For example, if one variable records time in 24 hours, all entries in that variable follow the same format.
- **Completeness:** Addressing missing values through the removal of incomplete records, with methods such as imputing values based on straightforward statistical techniques.
- **Uniformity:** Organising the dataset in a standardized and logical manner, complete with appropriately labeled variables and coherent data presentation.
- **Duplication Removal:** Eliminating duplicate entries to prevent any potential skewing of results.

In essence, the focus on data cleaning is paramount, ensuring that the raw marks obtained from student assessments are pristine before integration into the ASRMS. This preparatory step enables the system to function optimally, extracting meaningful patterns and insights while mitigating the impact of errors and inconsistencies inherent in raw assessment data.

4.6.2. Questionnaire Analysis: Understanding Stakeholder Perspectives

The analysis of the questionnaire is a pivotal aspect of the research, centering on the conversion of raw survey responses to glean insights into the development of an Automated Student Result Management System (ASRMS) tailored for Secondary Schools in the Nigerian Education Sector. Meticulously crafted, three distinct questionnaires were employed to capture essential perspectives on the significance of ASRMS implementation, encompassing participants from various roles such as teachers, students, and parents.

This methodological approach was strategic, aiming to foster a holistic understanding of the potential impact on educational management in secondary schools, incorporating diverse stakeholder groups. Nevertheless, it is crucial to recognize a significant limitation arising from the restricted number of participants engaged in the questionnaire survey. Although the research aspired to garner perspectives from a spectrum of stakeholders, including school administrators alongside the aforementioned groups, practical challenges involving logistics, time constraints, and limited access led to the involvement of a smaller subset of individuals in the survey.

In spite of this limitation, the collected responses furnish valuable insights from a representative subset within the target audience. The ensuing analysis entails the thorough examination and interpretation of this data, culminating in the derivation of meaningful insights and conclusions. Prior to delving into the specific survey findings, it remains essential to explicitly address the acknowledged limitation, thereby ensuring transparency regarding the constraints that influenced the extent of participant inclusion in the study.

1

[Questions](#) [Responses](#) (29) [Settings](#)

Section 1 of 12

Building an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector.

Legal Basis for Research: The Sheffield Hallam University conducts research as part of its role for the community's benefit under its legal status. In accordance with data protection regulations, we can utilise personal data for research, ensuring the appropriate safeguards are in place under the legal basis of public tasks serving the public interest. Your rights in detail can be found at: www.shu.ac.uk/about-this-website/privacy-policy/privacy-notices/privacy-notice-for-research. Every research effort by the University undergoes stringent review processes to safeguard participants. This specific research has received the necessary approvals from the University's Research Ethics Committee. More on this can be found: www.shu.ac.uk/research/excellence/ethics-and-integrity.

Opening Statement: You have been invited to take part in a research project. Before you make a decision, it is important to know why the research is being conducted and what it will entail. Please take the time to read this thoroughly and, if desired, discuss it with others. You can enquire about anything that is not clear by contacting me Akintunde.D.Ogunyemi@student.shu.ac.uk.

Purpose of the Research: The primary goal of this research is to create a tailored Automated Student Result Management System for Nigerian secondary schools. The project aspires to enhance efficiency in the education sector by automating result management processes. This endeavor seeks to address the unique needs of secondary education in Nigeria, empowering institutions to optimise administrative processes for improved academic experiences and educational progress.

Why have you been approached? This study is a learning activity that forms part of the MSc. Information Technology Management program at Sheffield Hallam University, United Kingdom. Your inclusion in this research is deliberate, as we seek diverse perspectives within the Nigerian education sector. Your participation is essential to garner a wide range of feedback, ensuring the proposed Automated Student Result Management System is designed to cater to the diverse needs and experiences of stakeholders in secondary schools.

Is participation mandatory? No. It is entirely up to you whether you wish to participate or not. There are no

Figure 14: The Proposed Question title (Source: Akintunde, 2023)

4.6.2.1. Types of Questionnaires Administered

As stated earlier, three types of questionnaires were administered. Below are the types of questionnaires administered and their links:

- Teacher Questionnaire (29 Responses Total):
<https://docs.google.com/forms/d/10cfBbMY36wzXIMxqbP1AEq5v5k3AkSi-LFcUWMoLVIg/edit>. 15 of the Responses are from teachers in Anchor Heights School while the remaining responses are from Focus Groups for Teachers.
- Student Questionnaire (10 Responses Total):
<https://docs.google.com/forms/d/1gJYrbfhkFJL9aBi23EK0U7u2s2mOnzNpZmXOfmO902s/edit>
- Parents Questionnaire (5 Responses Total):
<https://docs.google.com/forms/d/1x7tX8pcV9tBiCcGA97GcSWdhimDFM7R8fthpPVF2CD0/edit>

4.6.3. Questionnaire Responses.

The illustrations provided below depict the responses corresponding to each set of questions derived from the three distinct types of questionnaires employed in the survey.

4.6.3.1. Teacher Survey Summary

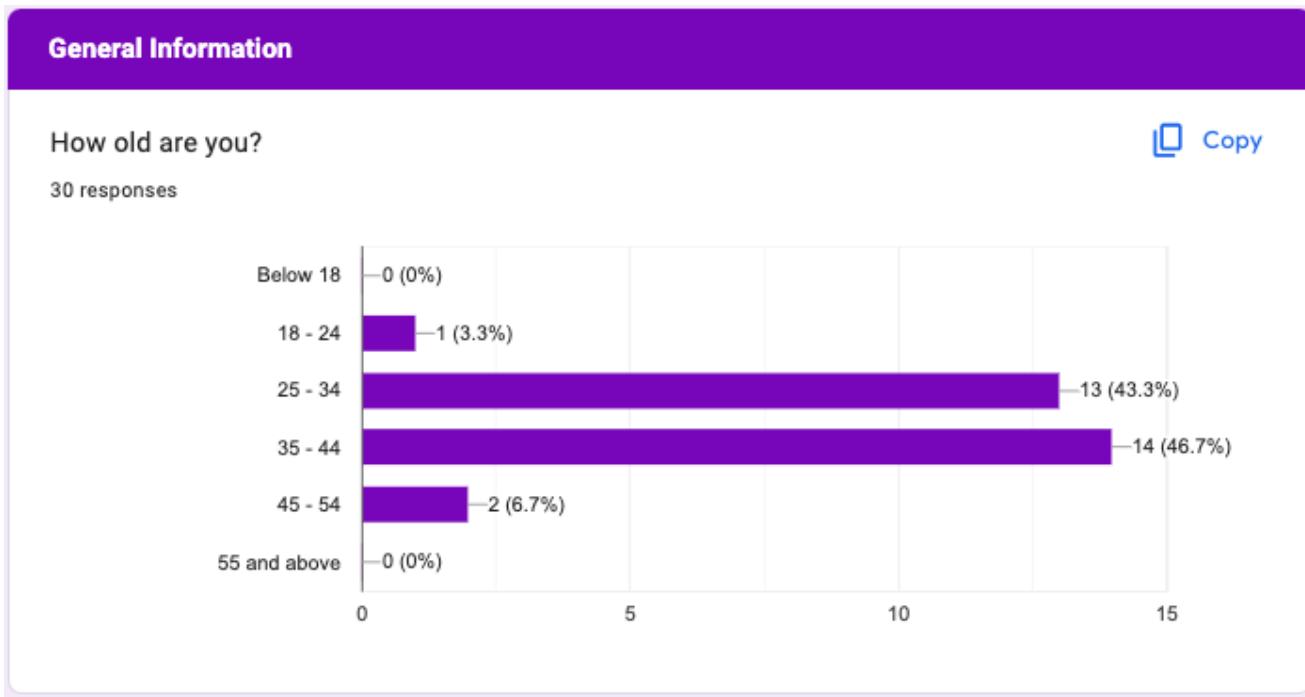


Figure 15: The Responses to Question 1 (Source: Akintunde, 2023)

The presented data regarding teachers in the survey depicts the age and gender distribution of the respondents. Analysis of the responses to question 1 reveals a predominant age group among the participants, with a substantial number falling within the 35 to 44 age range. Following closely are respondents aged 25 to 34, with a comparatively smaller representation in the 45 to 54 age range. This breakdown offers valuable insights into the demographic composition of the surveyed teacher population.

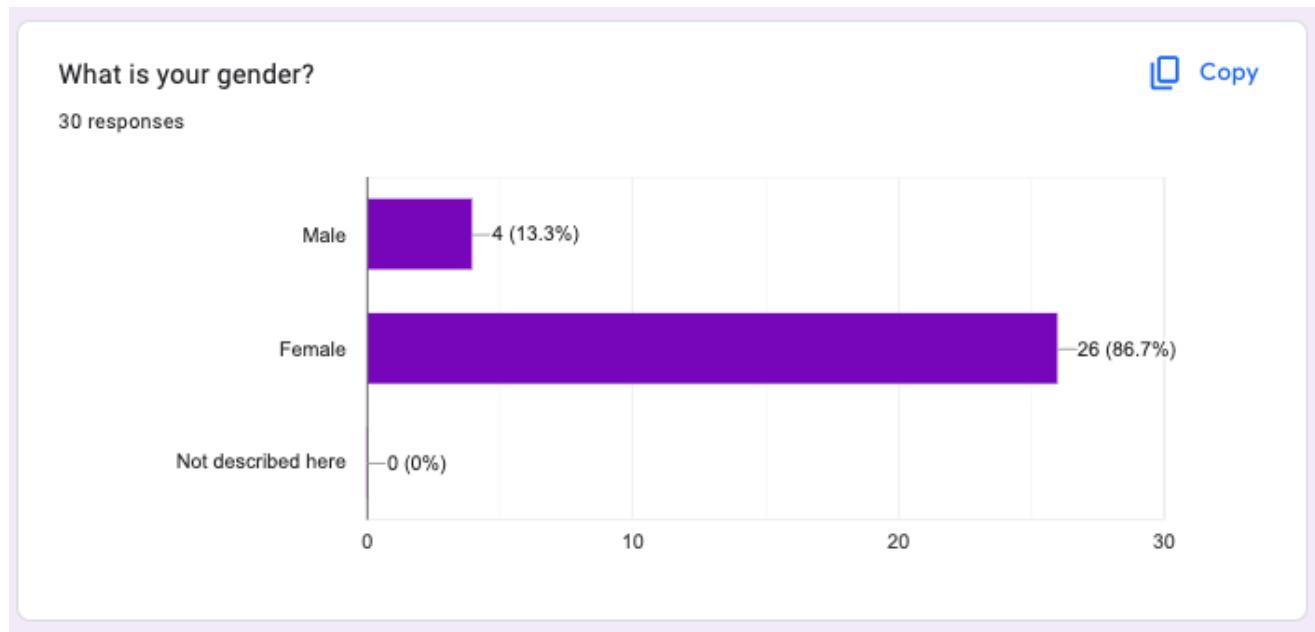


Figure 16: The Responses to Question 2 (Source: Akintunde, 2023)

Regarding question 2, the data highlights that 86.4% of the respondents identify as male, while the remaining 13.6% identify as female.

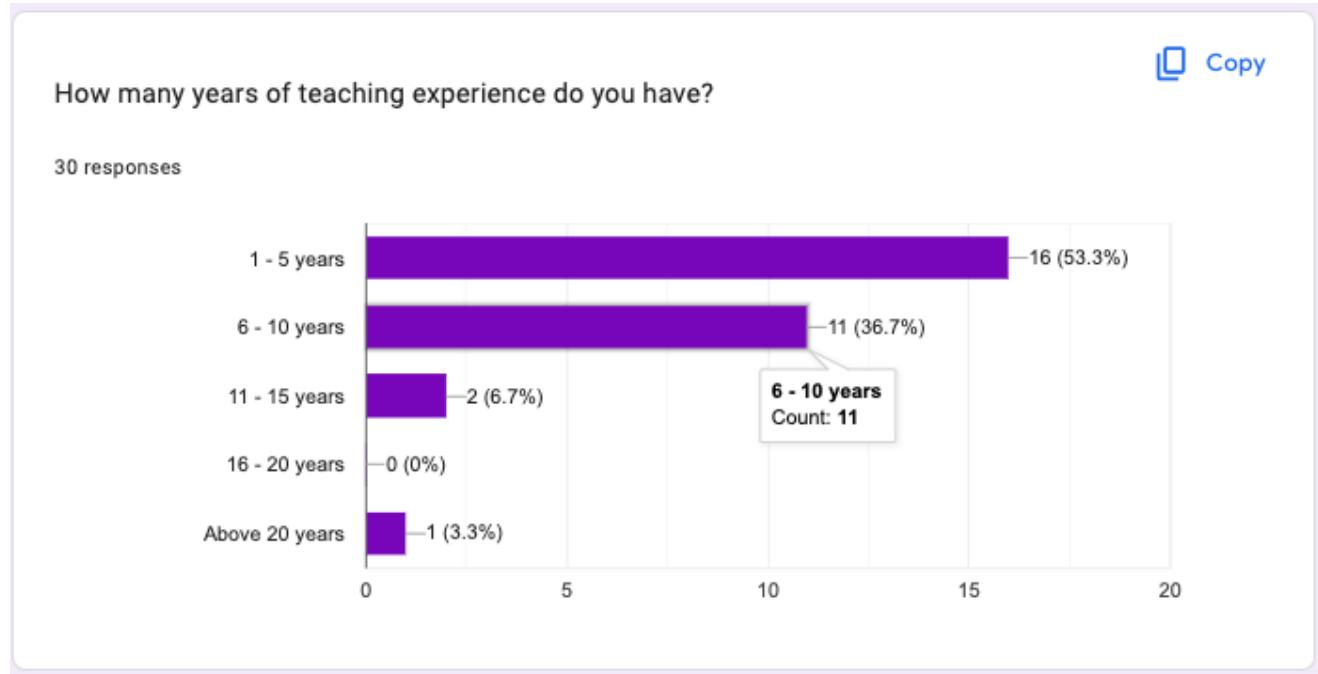


Figure 17: The Responses to Question 3 (Source: Akintunde, 2023)

In response to question 3, most respondents (53.3%) reported having 1 to 5 years of teaching experience, while 36.7% had 6 to 10 years, and 6.7 % had 11 to 15 years. This distribution indicates that a significant portion of surveyed teachers is relatively early in their careers, impacting their familiarity with technology, including an ASRMS.

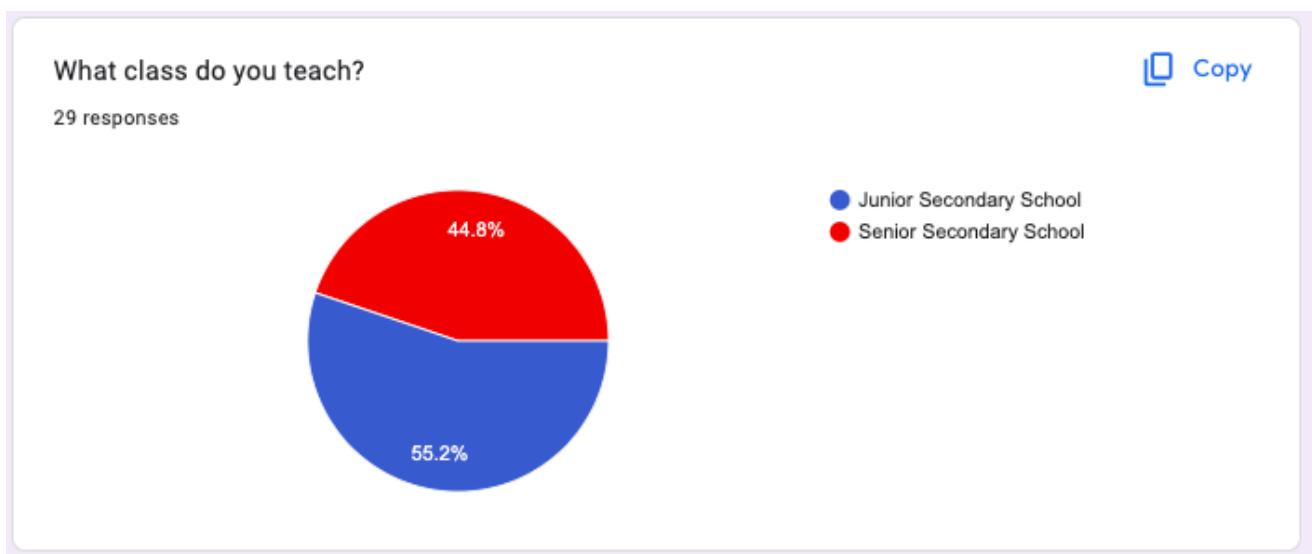


Figure 18: The Responses to Question 4 (Source: Akintunde, 2023)

Regarding question 4, the data indicates that 55.2% of respondents teach Junior Secondary School, while 44.8% teach Senior Secondary School classes.

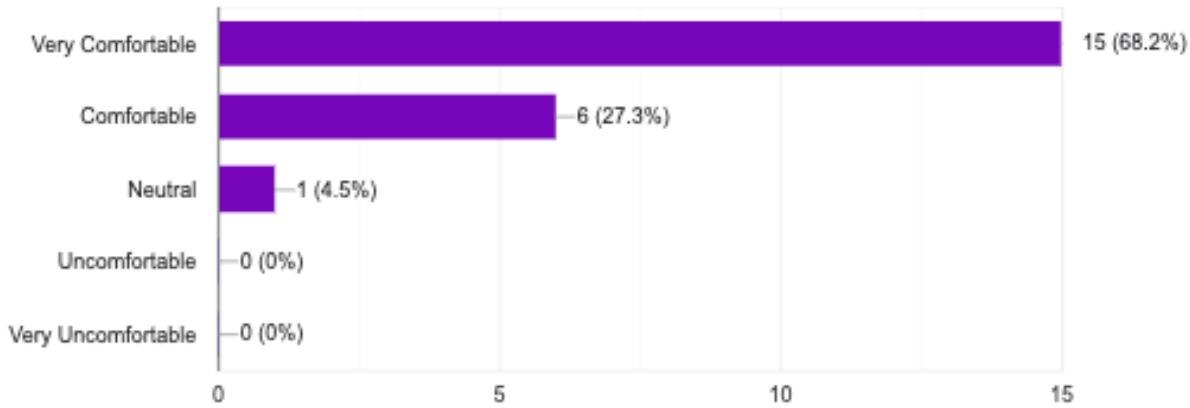


Figure 19: The Responses to Question 5 (Source: Akintunde, 2023)

Question 5 relates the experience and technological proficiency of the teachers. A review shows that 68.2% of the teachers are very comfortable with using technology for academic-related tasks. 27.3% are comfortable using technology for academic-related tasks and 4.5% of these teachers are neutral to such feat. This positive response suggests a favorable environment for the implementation of technological solutions, such as an Automated Student Result Management System (ASRMS), as a considerable portion of teachers is well-acquainted and at ease with technology.

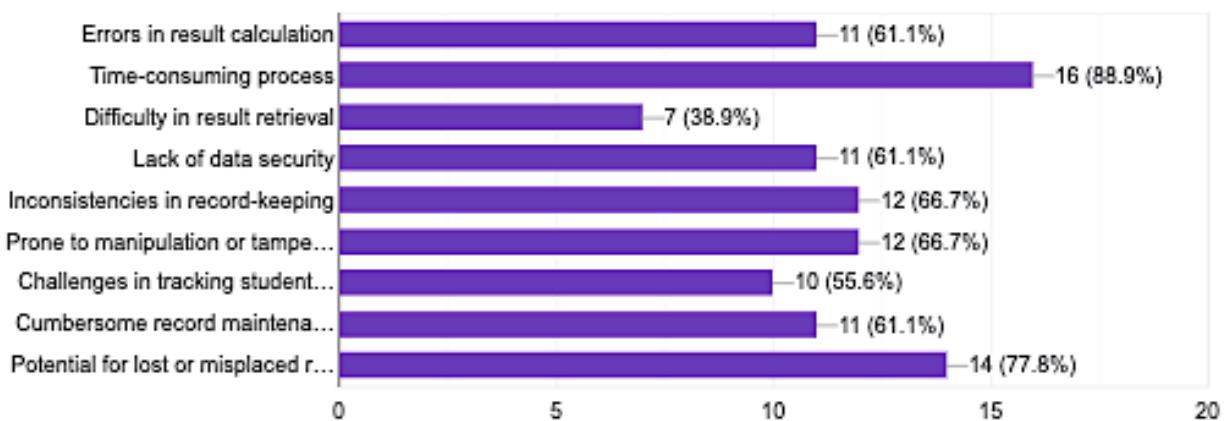


Figure 20: The Responses to Question 6 (Source: Akintunde, 2023)

Question 6 indicate respondents identify several challenges with the current manual result management system, including errors in result calculation, time-consuming processes, difficulty in result retrieval, lack of data security, inconsistencies in record-keeping, susceptibility to manipulation, challenges in tracking student progress, and cumbersome record maintenance. These issues underscore the need for an automated system to address efficiency, accuracy, and security concerns.

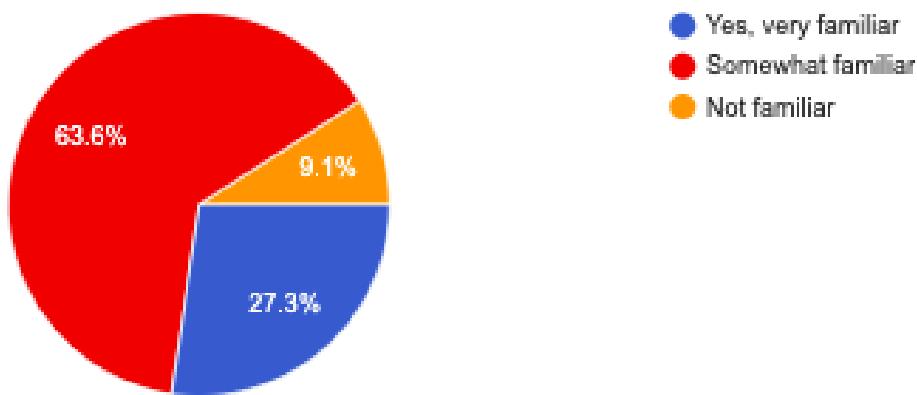


Figure 21: The Responses to Question 7 (Source: Akintunde, 2023)

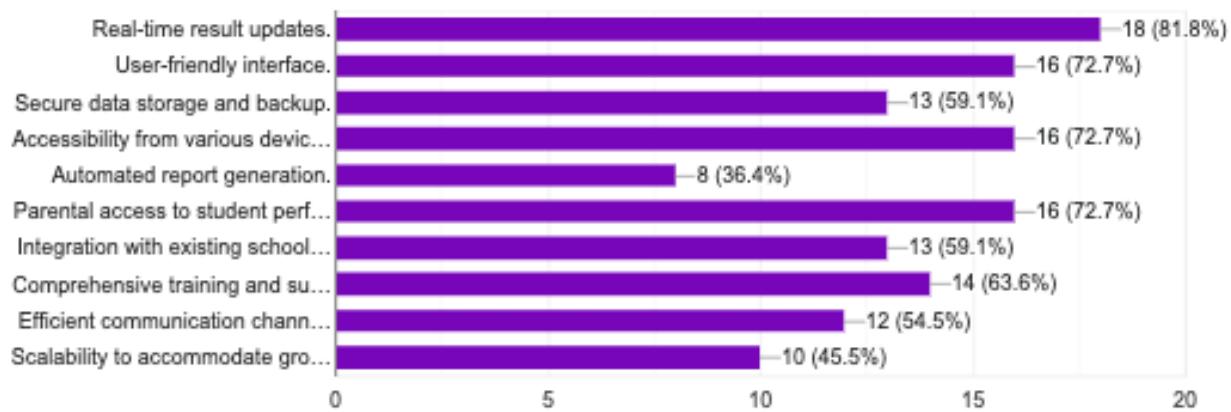


Figure 22: The Responses to Question 8 (Source: Akintunde, 2023)

In question 7, a majority of respondents (63.6%) are somewhat familiar with the concept of an automated student result management system, while 27.3% are very familiar with the concept and 9.1%

are not familiar with the concept. This indicates a reasonable awareness level, with a potential need for further education or information dissemination to enhance understanding among participants.

Question 8 indicates that respondents' expectations for the Automated Student Result Management System (ASRMS) include a strong emphasis on real-time result updates, a user-friendly interface, secure data storage, accessibility from various devices, and parental access. These priorities reflect a demand for efficiency, security, convenience, and inclusive parental involvement in academic monitoring.

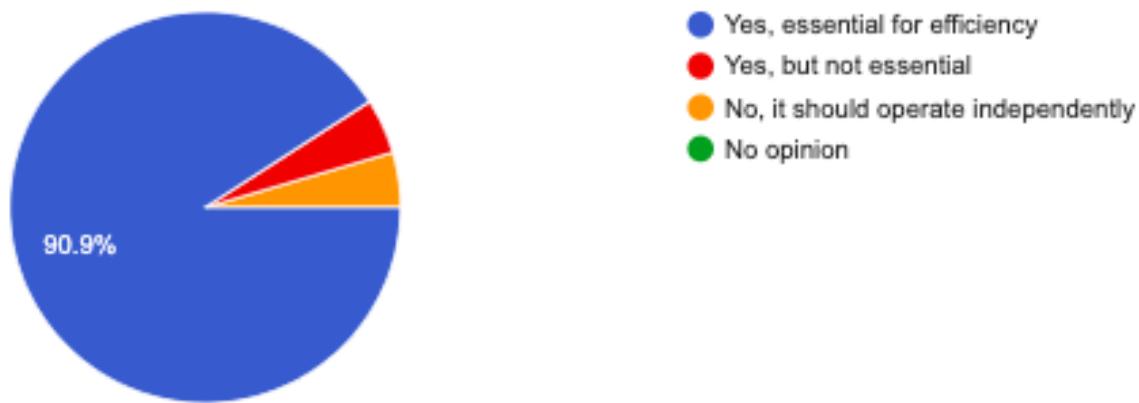


Figure 23: The Responses to Question 9 (Source: Akintunde, 2023)

In question 9, a vast majority of respondents (90.9%) believe that the new system should integrate seamlessly with other existing school management systems, emphasizing the perceived importance of efficiency through integration. Only a small percentage (4.5%) expresses a view that integration is not essential or holds no opinion on the matter. This underscores the significance of a cohesive technological infrastructure within the school management landscape.

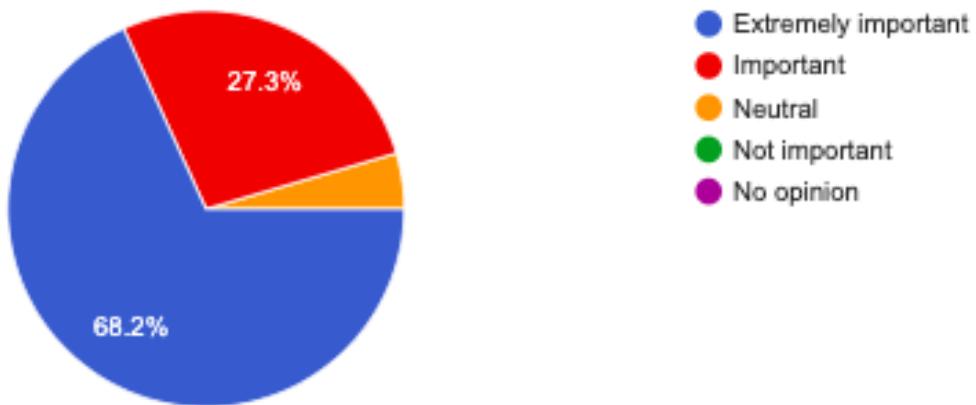


Figure 24: The Responses to Question 10 (Source: Akintunde, 2023)

In question 10, a significant majority of respondents (95.5%) emphasize the importance of a user-friendly interface in an automated result management system, with 68.2% considering it important and 27.3% rating it as extremely important. This collective sentiment underscores the significance of an intuitive and accessible user interface for the successful implementation and user acceptance of the Automated Student Result Management System.

In question 11 (see figure 4.13 below), a substantial majority of respondents (95.5%) consider comprehensive training and support for school staff during the implementation phase of the new system to be crucial or extremely crucial. This overwhelming consensus underscores the significance of adequately preparing and supporting staff for the successful adoption and integration of the Automated Student Result Management System.

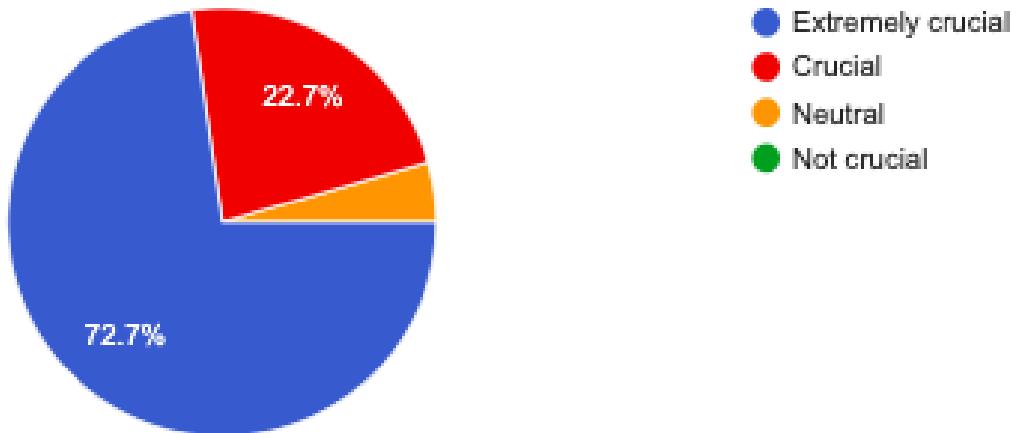


Figure 25: The Responses to Question 11 (Source: Akintunde, 2023)

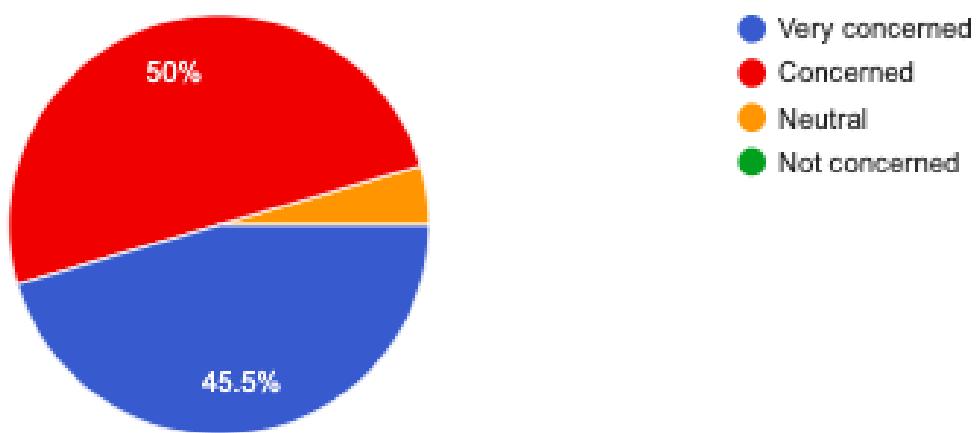


Figure 26: The Responses to Question 12 (Source: Akintunde, 2023)

In question 12, a majority of respondents' express concerns about the security of student data in an automated system, with 50% stating that they are either "very concerned" or "concerned." This highlights the paramount importance of implementing robust security measures to address apprehensions and ensure the integrity and confidentiality of student information in the Automated Student Result Management System.

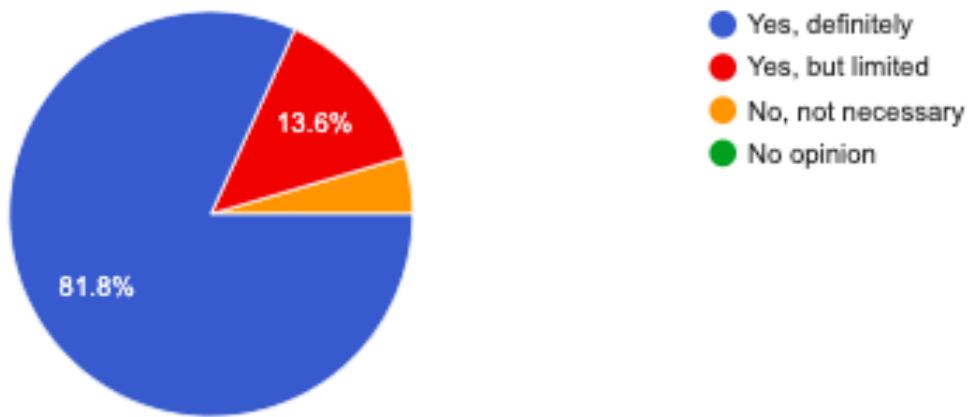


Figure 27: The Responses to Question 13 (Source: Akintunde, 2023)

In question 13, a significant majority of respondents, comprising 81.8%, believe that the Automated Student Result Management System should include a feedback mechanism for teachers. This strong endorsement emphasises the perceived importance of establishing channels for reporting issues and suggesting improvements, indicating a collaborative approach to system enhancement and continuous improvement.

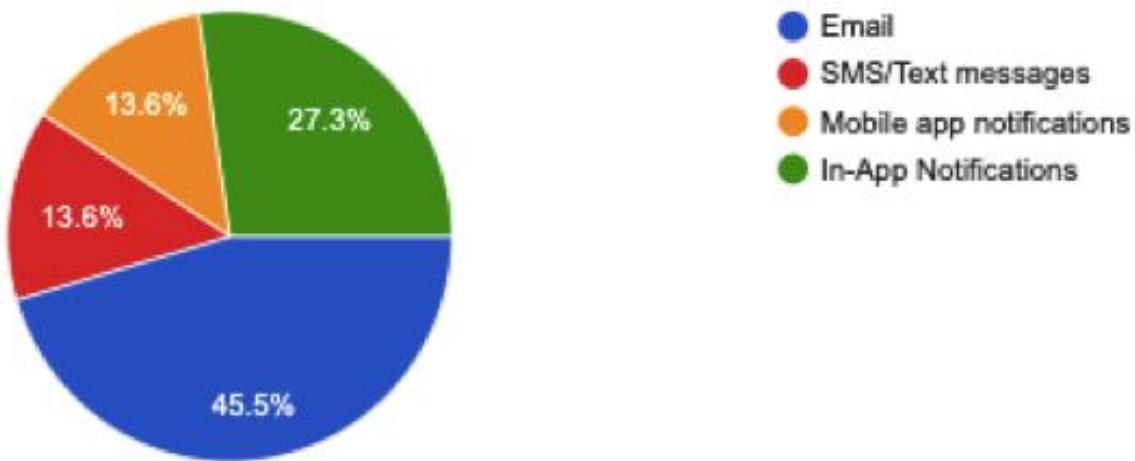


Figure 28: The Responses to Question 14 (Source: Akintunde, 2023)

Regarding communication preferences for system updates and notifications, as seen in question 14, 45.5% of respondents prefer in-app notifications, 27.3% prefer email, 13.6% favor SMS/text messages,

and another 13.6% opt for mobile app notifications. This diverse distribution highlights the importance of offering multiple communication channels to cater to varying preferences among users.

The overall willingness to adopt the automated student result management system is notably high, with 72.7% expressing a likelihood to adopt (27.3% "Very Likely" and 45.5% "Likely"). This positive response underscores the potential acceptance and enthusiasm for the proposed system among the surveyed participants.

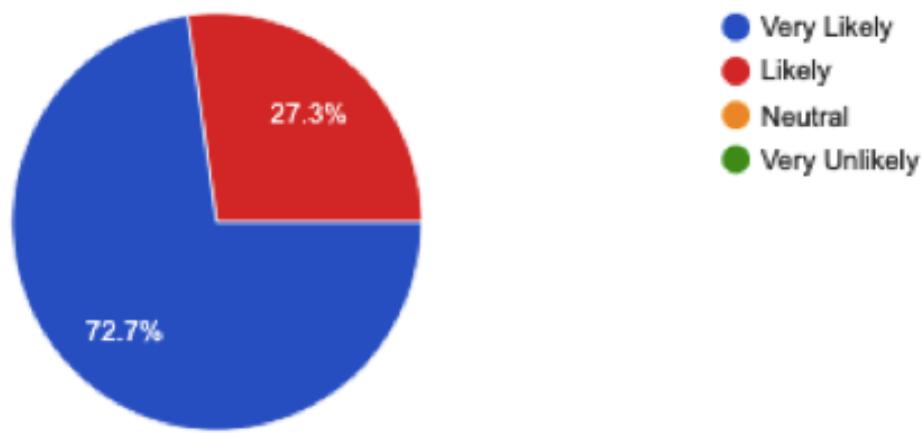


Figure 29: The Responses to Question 15 (Source: Akintunde, 2023)

4.6.3.2. Student Survey Summary

An overall review of the student survey, conducted with a sample size of 10 respondents, provides valuable insights into the expectations, preferences, and willingness of students regarding the proposed Automated Student Result Management System (ASRMS) for Secondary Schools in the Nigerian Education Sector. The responses from students regarding the ASRMS indicate a high level of awareness, positive expectations, and a strong willingness to adopt the system.

This response is as seen in the link highlighted below:

<https://docs.google.com/forms/d/1gJYrbfhkFJL9aBi23EK0U7u2s2mOnzNpZmXOfmO902s/edit#responses>

An overview of the implication of the responses is expressed below:

- **General Information**

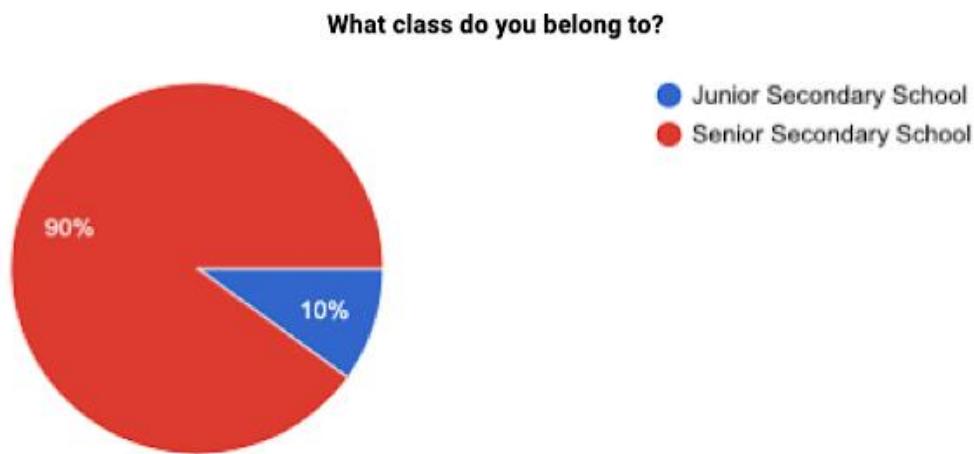


Figure 30: The Responses to Student Survey Question 4 (Source: Akintunde, 2023)

- **Awareness and Expectations:**

- Students show a high level of awareness of the ASRMS concept, with 60% being very familiar. This showcases a high level of awareness and understanding among the student body.

Are you aware of the concept of an automated student result management system?

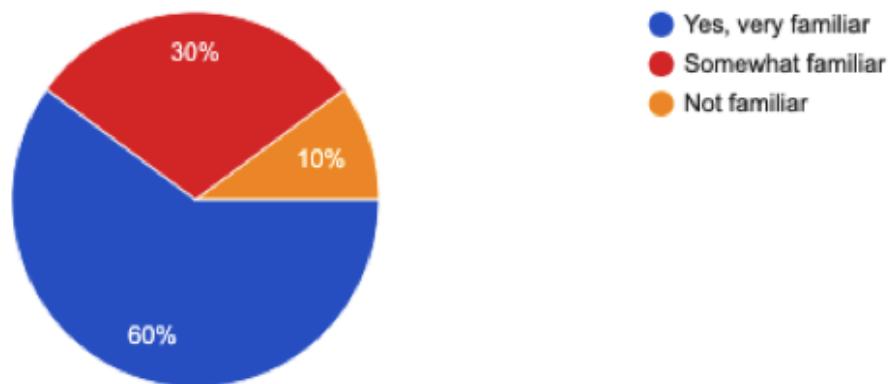


Figure 31: The Responses to Student Survey Question 5 (Source: Akintunde, 2023)

- Expectations focus on real-time result updates, a user-friendly interface, secure data storage, and comprehensive training. This reflects a desire for a system that is not only technologically advanced but also prioritises accessibility, ease of use, security, and proper training to ensure a positive and effective user experience.

What expectations do you have for such a system?

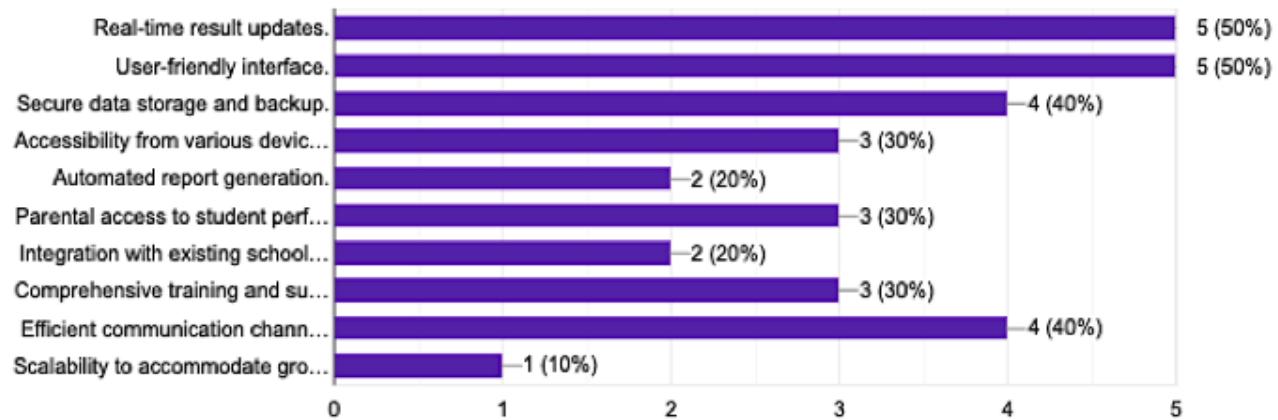


Figure 32: The Responses to Student Survey Question 6(Source: Akintunde, 2023)

- **User Interface Preferences:**

- A majority of students (60%) consider a user-friendly interface extremely important, emphasizing the significance of a user-centric design.

- **Access to Information:**

- Students overwhelmingly support real-time access to their academic performance data, with 60% expressing a strong preference for continuous access.

- **Parental Access:**

- A considerable portion (50%) believes that parents should always have access to their academic results through the system, indicating openness to parental involvement.

- **Data Security and Confidentiality:**

- The majority of students (60%) express very high concern for the security of student data, emphasizing the importance of robust data protection measures.

- **Ease of Use:**

- An overwhelming 80% of students consider ease of use without extensive training as very important, underscoring the need for a user-friendly system.

- **Feedback Mechanism:**

- Students strongly advocate for a feedback mechanism, with 90% endorsing the inclusion of features for teachers to report issues or suggest improvements.

- **Device Accessibility:**

- A significant portion (70%) deems it extremely essential to access the system from various devices, highlighting the importance of multi-device compatibility.

- **Communication Channels:**

- The preferred communication channels for students include email (50%), SMS/Text messages (30%), and mobile app notifications (20%).

- **Satisfaction and Willingness to Adopt:**

- An impressive 80% of students express a high likelihood of adopting and using the ASRMS based on the described features.

It is crucial to note that the survey's comprehensive nature, capturing diverse aspects of student perspectives, provides a robust foundation for designing an ASRMS that aligns with student expectations and preferences. The positive disposition and high willingness to adopt indicate a favorable reception among students toward the envisioned system.

4.6.3.3. Parents Survey Summary

The parental survey, encompassing a modest sample of 5 respondents, offers insightful perspectives on expectations and concerns related to the proposed Automated Student Result Management System (ASRMS) for Secondary Schools in the Nigerian Education Sector. The responses, accessible through the following link:

<https://docs.google.com/forms/d/1x7tX8pcV9tBiCcGA97GcSWdhimDFM7R8fthpPVF2CD0/edit#responses>, reveal a commendable level of awareness, positive expectations, and a notable willingness among parents to adopt the ASRMS. This indicates a favorable reception from parents toward the envisioned system. Below is a summary of responses:

- Demographic Insights:**

- The majority of respondents (60%) fall within the age range of 35 to 44, indicating a concentration in the middle-age group.
- Gender distribution among respondents shows a balanced representation, with 60% male and 40% female participants.

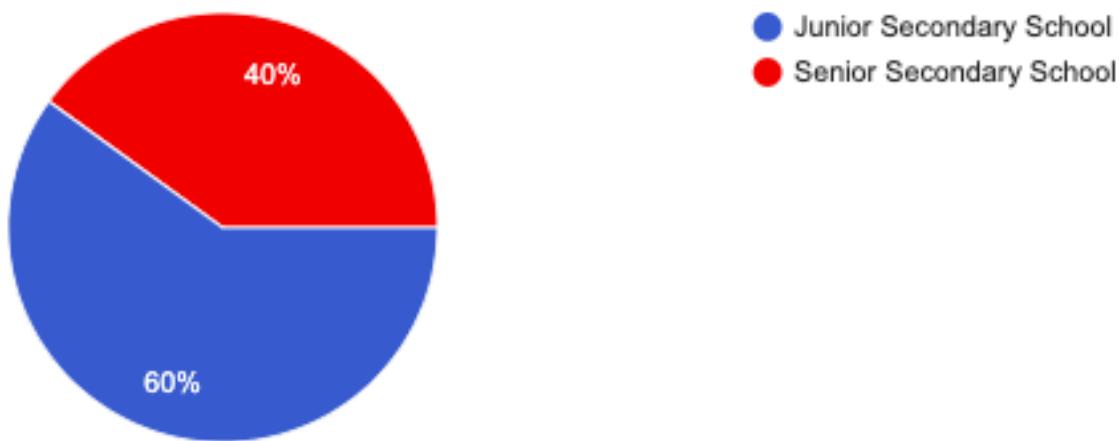


Figure 33: The Responses to Parent Survey Question 4 (Source: Akintunde, 2023)

- **Awareness and Expectations:**
 - A significant percentage (60%) of respondents expressed familiarity with the concept of an ASRMS.
 - Key expectations of the system revolve around real-time result updates, user-friendly interface, secure data storage, accessibility from various devices, automated report generation, parental access to student performance, integration with existing school systems, comprehensive training, efficient communication channels, and scalability.

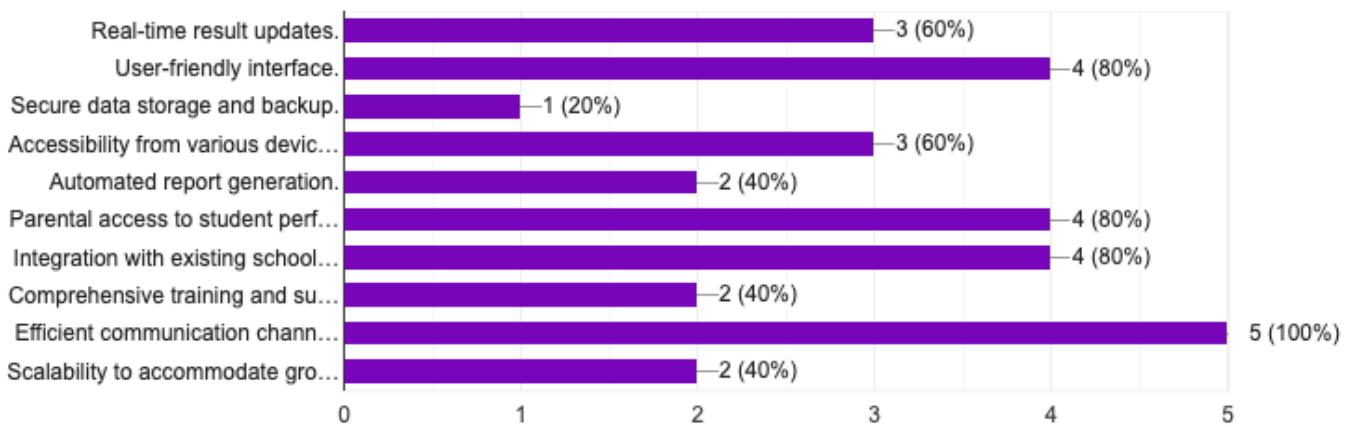


Figure 34: The Responses to Parent Survey Question 7 (Source: Akintunde, 2023)

- **Concerns and Importance Factors:**
 - Accessibility to the system is deemed extremely important by 80% of respondents.
 - 60% of respondents are very concerned about the security of their child's academic data in the automated system.
 - Ease of use is considered very important by 80% of participants.
- **Communication Preferences:**
 - The preferred communication channels for system updates and notifications include email (40%), SMS/text messages (20%), mobile app notifications (20%), and in-app notifications (20%).

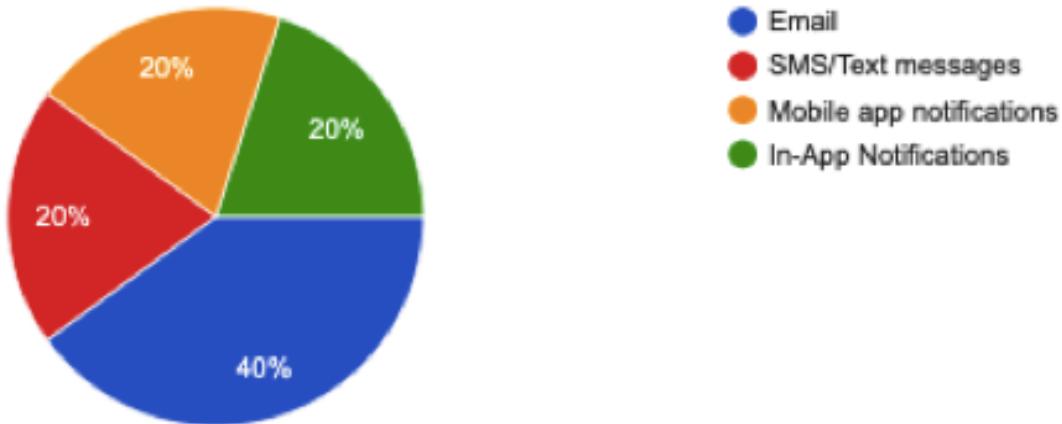


Figure 35: The Responses to Parent Survey Question 14 (Source: Akintunde, 2023)

- **Willingness to Adopt:**

- A unanimous agreement (100%) among respondents indicates a high likelihood of adopting and using the proposed ASRMS.

The small sample size of 5 respondents limits the scope of the findings, yet it offers an initial understanding of parental perspectives. The overall positive inclination towards adopting the ASRMS is encouraging. Parents are generally aware of the system, have substantial expectations, and express willingness to embrace it. Nevertheless, the concerns raised, particularly regarding data security and accessibility, highlight areas that need careful consideration in the design and implementation of the Automated Student Result Management System. Addressing these concerns will contribute to building a system that aligns effectively with the needs and expectations of parents in the Nigerian education sector.

4.7. Chapter Summary

This chapter delineates the practical implementation of an Automated Student Result Management System (ASRMS) for Secondary Schools in the Nigerian Education Sector, transitioning from theoretical foundations. Adopting a qualitative, exploratory approach, the study employs semi-

structured interviews to discern how information technologies and business process automation can optimise student result management.

The planning phase entails meticulous project charting utilising a Project Plan and Gantt Chart, focusing on resource optimisation and productivity. Data collection combines interviews and online questionnaires, delving into stakeholder perspectives to identify automation opportunities. Functional and non-functional requirements are derived from the collected data, prioritised using the Kano Model to define key system features.

Guided by the Unified Theory of Acceptance and Use of Technology (UTAUT), the study incorporates two key participants: A Principal and a Data Entry Officer. Thematic analysis of the interviews yields four key themes:

- Efficiency and Accuracy: Automation emerges as a solution to reduce turnaround time, eliminate errors, and enhance overall efficiency in academic result management. The focus lies on automated result calculations, data validation, and intuitive interfaces.
- User Accessibility: Both participants emphasise the transformative impact of ASRMS on user accessibility, highlighting benefits such as improved efficiency, reduced workload, and heightened accuracy in result calculations. A user-friendly interface and ongoing support and training for staff are key priorities.
- Enhanced Educational Processes: ASRMS is perceived as a fundamental improvement in result management, streamlining processes, enabling insightful analysis, and fostering a dynamic educational environment.
- Data Security and Privacy: Robust security measures, including encryption techniques and access controls, are underscored to safeguard student data within ASRMS, instilling trust and contributing to a positive user experience.

The chapter concluded with the presentation and analysis of research data, utilising tables, charts, graphs, and figures to vividly portray ASRMS project findings. Preliminary interviews validated main study questions, and the thematic framework offered valuable insights into the potential impact of ASRMS implementation in Nigerian secondary schools.

The questionnaire analysis involved three categories: Teacher, Student, and Parent questionnaires. Despite participant limitations, responses provided valuable insights. Teachers expressed the need for an automated system due to challenges with the then-current manual process. Students exhibited a high awareness level, positive expectations, and a strong willingness to adopt the ASRMS. Parents also showed awareness, positive expectations, and unanimous willingness to adopt, with concerns centered on data security and accessibility.

In summary, the study offers a holistic understanding of stakeholder perspectives, paving the way for the design of an ASRMS aligned with the needs and expectations of the Nigerian education sector. The positive reception from participants underscores the potential success and impact of the proposed system.

Chapter Five

Automated Student Result Management System – The Development Process

5.0. Introduction

This study explores potential benefits of implementing an Automated Student Result Management System (ASRMS) designed specifically for secondary schools within the Nigerian Education Sector. The primary focus is elevating efficiency and accuracy in the result-processing workflow. Through semi-structured interviews, an in-depth understanding of the current state of result management in secondary schools was gained. Building upon these insights, a proof-of-concept ASRMS was meticulously designed. The conceptual framework delineates the ASRMS ecosystem, offering a comprehensive overview of the technology employed to streamline result processing, ensure accuracy, and facilitate the monitoring of overall academic progress.

5.1. Software Development Methodology

The development of an Automated Student Result Management System for the Nigerian Education Sector demands a robust software development methodology to ensure high-quality, reliable, and timely delivery. Mahapatra & Goswami (2009) emphasise that a software development methodology is a formalised approach used in the software industry to create products meeting stringent standards. It provides an organisational environment for planning, directing, and executing the software development process (Verma et al., 2014).

Khan et al. (2011) enumerated various methodologies applicable to software development, including waterfall, agile, scrum, rapid application development (RAD), spiral, and hybrid approaches. Strategically chosen in alignment with the project's goals, the RAD prototype methodology fits seamlessly with the requirement for a secure and interactive Student Result Management System for Anchor Group of Schools.

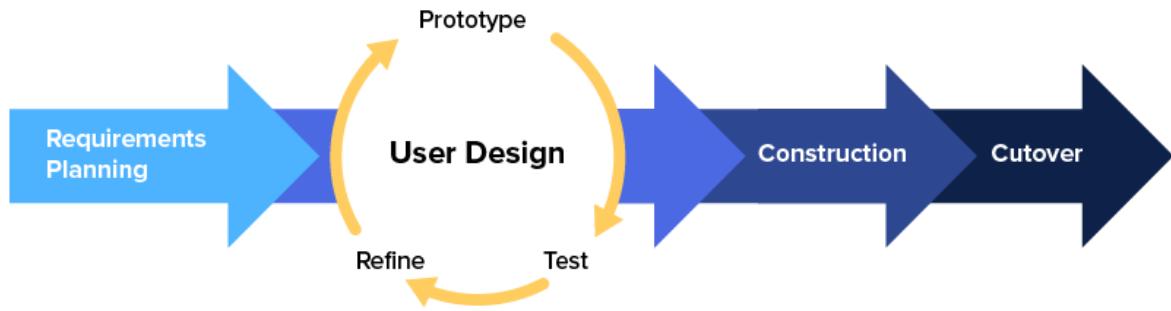


Figure 5.1: Rapid Application Development (RAD) Methodology (Source: Kurniadi et al., 2019)

The RAD methodology, known for its iterative and incremental approach, is apt for projects requiring flexibility and continuous user engagement. This aligns well with the development of an interactive software application, where prototypes can be rapidly developed, tested, and refined through user feedback. Object-oriented programming principles will be leveraged to ensure code reusability, enhancing efficiency throughout the RAD development cycles. A significant disadvantage of this model is that it may lead to wastage of development and delivery time due to different changing requirements stakeholders.

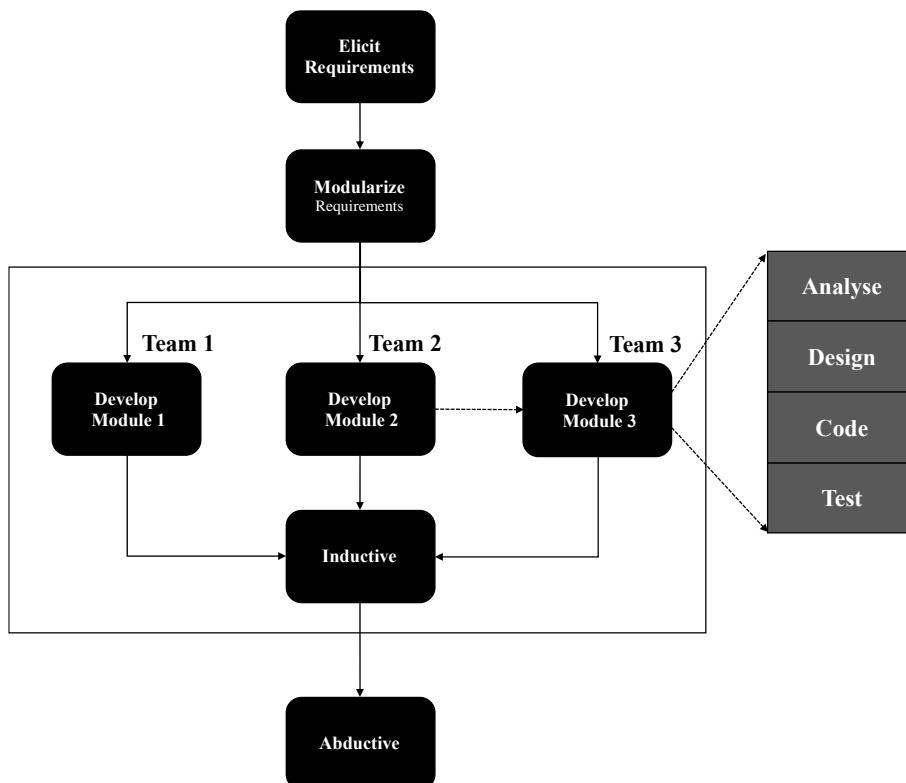


Figure 5.2: Stages of the application of the RAD method in website development. (Source: Adapted from Delima et al., 2017)

Adopting the RAD prototype methodology is a deliberate choice for building the Student Result Management System due to its quick delivery time, considering the short timeframe for developing the project deliverable. This methodology promises to facilitate a dynamic and responsive development process, ensuring the software product meets the highest standards demanded by the Nigerian education sector (Mahapatra & Goswami, 2009).

Table 5.1: Comparison between methodologies (Source: Akintunde, 2023)

Criteria	Waterfall	Agile	Scrum	RAD	Spiral
Alignment with Project Objectives	No	Yes	Yes	Yes	Yes
Efficiency and Flexibility	No	Yes	Yes	Yes	Yes
Error Detection	No	Yes	Yes	Yes	Yes
Reusability of Components	No	Yes	Yes	Yes	Yes
User Involvement	No	Yes	Yes	Yes	Yes
Flexibility and Adaptability to Change	No	Yes	Yes	Yes	Yes
Time Sensitivity	No	Yes	Yes	Yes	Yes
Prototyping Advantage	No	No	No	Yes	No
Continuous User Validation	No	Yes	Yes	Yes	No

5.2. Functional and Non-functional Requirements

When building an automated Student Result Management System (SRMS) for secondary schools, it is essential to define functional and non-functional requirements to ensure that the system meets the needs and expectations of all stakeholders. The study relied on qualitative data acquired through interviews and survey questionnaires. Analysis of this data led to the identification and formulation of various functional and non-functional requirements, serving as the cornerstone in guiding the development of the innovative system. The development process strictly adhered to the Rapid Application Development (RAD) model, leveraging the principles of object-oriented programming. Additionally, a mobile/web-

based approach was employed in the software development, aligning with the research objectives and contributing to the system's efficacy and responsiveness.

Functional requirements define the specific features and capabilities the Automated Student Result Management system must possess to meet user needs and expectations. Non-functional requirements describe the quality attributes and constraints of the system. These requirements ensure that the app performs efficiently and meets the necessary standards.

Table 5.2: Functional and Non-functional Requirements for the Proposed Project. (Source: Akintunde, 2023)

#	Functional Requirements	Non-functional Requirements
1	User Authentication and Access Control: <ul style="list-style-type: none"> - Secure login and user roles (admin, teacher, student, parent). - Password policies and password recovery. 	Performance: <ul style="list-style-type: none"> - System responsiveness and speed, even with a large number of concurrent users. - Quick retrieval of results and reports.
2	Result Entry and Management: <ul style="list-style-type: none"> - The ability for teachers to input student results. - Verification and validation of result data. - Option to update and edit results. - Automated calculation of final grades. 	Reliability: <ul style="list-style-type: none"> - High system availability (minimal downtime). - Data integrity and accuracy.
3	Data Storage and Management: <ul style="list-style-type: none"> - Secure storage of student information and academic records. - Data backup and recovery procedures. 	Scalability: <ul style="list-style-type: none"> - Ability to handle increased data volume over time.

#	Functional Requirements	Non-functional Requirements
4	<p>Reporting and Analytics:</p> <ul style="list-style-type: none"> - Generation of customisable result reports. - Analytics to identify trends, student performance patterns, and areas for improvement. - Graphical representation of data (charts and graphs). 	<p>Security:</p> <ul style="list-style-type: none"> - Protection against data breaches and unauthorised access. - Regular security updates and patches.
5	<p>Communication:</p> <ul style="list-style-type: none"> - Notifications to parents and students about results. - Messaging and alerts for teachers and administrators. 	<p>Usability:</p> <ul style="list-style-type: none"> - Intuitive and user-friendly interface. - Minimal training required for users.
6	<p>Data Security:</p> <ul style="list-style-type: none"> - Encryption of sensitive data. - Access control to prevent unauthorized data tampering. - Compliance with data protection regulations. 	<p>Compliance:</p> <ul style="list-style-type: none"> - Adherence to local and international data protection laws. - Compliance with educational standards.
7	<p>Scalability:</p> <ul style="list-style-type: none"> - Ability to accommodate a growing number of students and records. 	<p>Compatibility:</p> <ul style="list-style-type: none"> - Cross-browser and cross-platform compatibility. - Integration with existing school infrastructure.
8	<p>User-Friendly Interface:</p> <ul style="list-style-type: none"> - Intuitive and easy-to-use design for teachers, students, and parents. 	<p>Maintenance:</p> <ul style="list-style-type: none"> - Ease of system updates and maintenance. - Availability of technical support.
9	<p>Integration:</p> <ul style="list-style-type: none"> - Compatibility with other educational systems and platforms. 	

#	Functional Requirements	Non-functional Requirements
10	<p>Customisation:</p> <ul style="list-style-type: none"> - Flexibility to adapt the system to the specific needs of the school. 	

Defining these functional and non-functional requirements is crucial to guide the development of the ASRMS and ensure that it effectively serves the needs of secondary schools in the Nigerian education sector.

5.3. Prioritisation of Requirements

The collected data revealed that functional and non-functional requirements were identified for the proposed system. Functional requisites encompassed features such as user registration/login, result publication, grade management, and communication tools. Simultaneously, non-functional aspects, including system availability, data confidentiality, integrity, security, and compatibility, were outlined to ensure a robust and secure system.

To discern user preferences and prioritise system features, the Kano Model was employed. Recognised as a product development and customer satisfaction framework, the Kano model aids in categorising and prioritising features based on their impact on user satisfaction (Aslamiyah, 2023, p. 3; Xu et al., 2009). Kano et al. (1984) introduced the Kano Model to categorise customer requirements into five groups: Must-Have (Must-be), Performance Needs (One-Dimensional), Excitement Needs (Attractive), Indifferent Needs, and Reverse Needs (Dissatisfiers). Each category influences consumer satisfaction uniquely, highlighting the nonlinear relationship between requirements' performance and customer satisfaction (Martí Bigorra et al., 2019; Lizarelli et al., 2021).

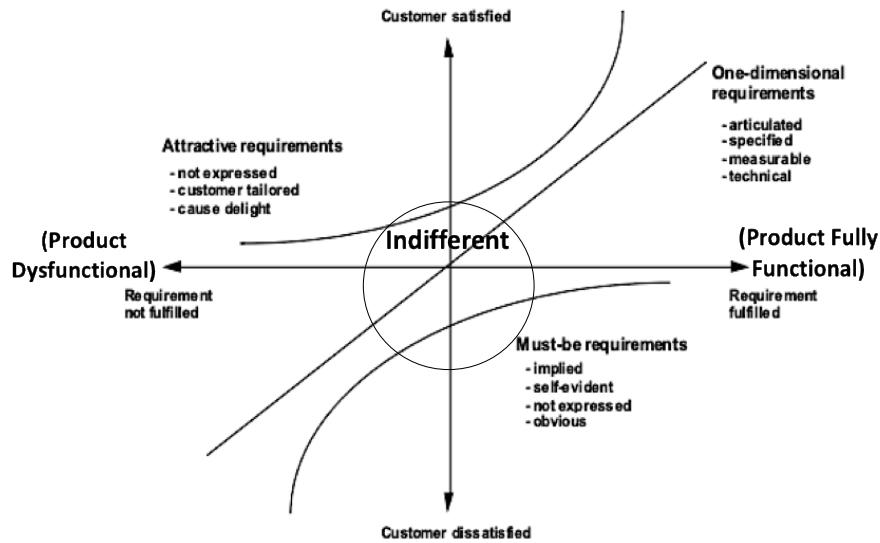


Figure 5.3: Kano's model (Adopted from Kano et al., 1984))

Despite its effectiveness, the traditional Kano model relies on qualitative analysis, presenting challenges in practical management due to subjective criteria (Lizarelli et al., 2021; Violante and Vezzetti, 2017). To address these limitations, scholars, such as Matzler and Hinterhuber (1998) and Xu et al. (2009), have proposed quantitative approaches to the Kano model, enhancing its applicability and precision. Below is the step-by-step guide for incorporating the Kano Model into this research.

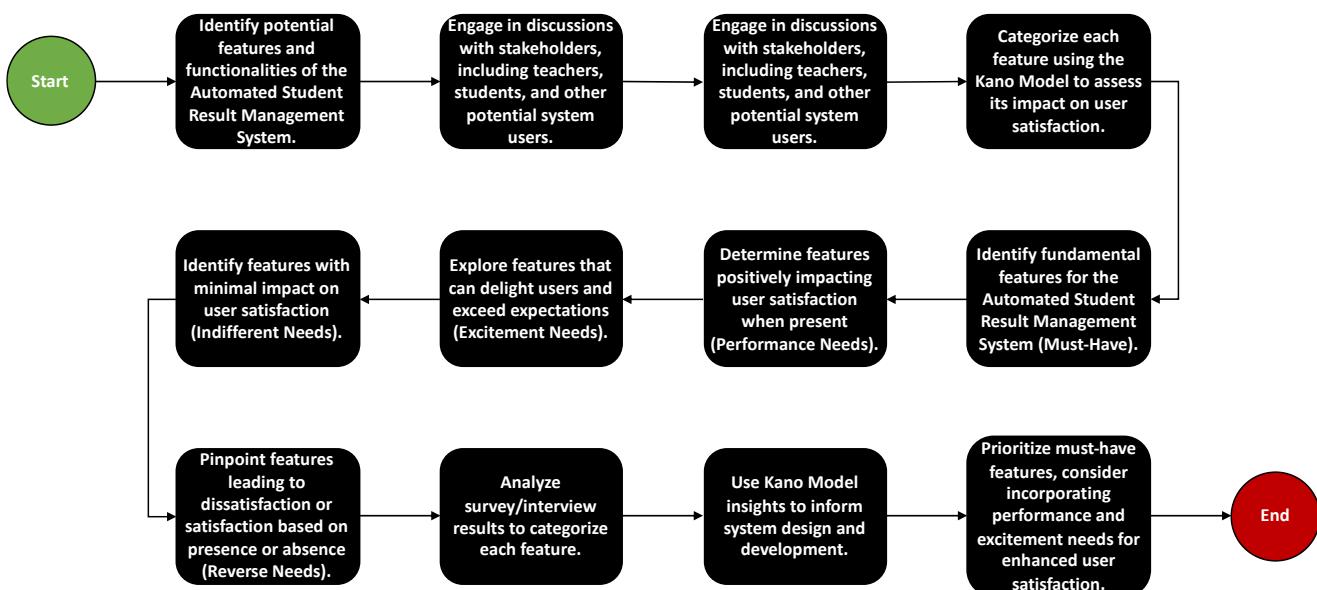


Figure 5.4: Kano's model of customer satisfaction (Source: Adapted from Kano et al., 1984)

Table 5.3: Proposed Identification of Automated Student Result Management System Features using Kano Categories (Source: Adapted from Kano et al., 1984)

S/N	Kano Categories	System Features/Implementation
1	Must-Have (Basic Needs)	<p>User Authentication and Access Control</p> <ul style="list-style-type: none"> - Secure login and user roles (admin, teacher, student, parent) - Password policies and password recovery
2	Must-Have (Basic Needs)	<p>Result Entry and Management</p> <ul style="list-style-type: none"> - The ability for teachers to input student results - Verification and validation of result data - Option to update and edit results - Automated calculation of final grades
3	Must-Have (Basic Needs)	<p>Data Storage and Management</p> <ul style="list-style-type: none"> - Secure storage of student information and academic records - Data backup and recovery procedures
4	Must-Have (Basic Needs)	<p>Reporting and Analytics</p> <ul style="list-style-type: none"> - Generation of customizable result reports - Analytics to identify trends, student performance patterns, and areas for improvement - Graphical representation of data (charts and graphs)
5	Must-Have (Basic Needs)	<p>Communication</p> <ul style="list-style-type: none"> - Notifications to parents and students about results - Messaging and alerts for teachers and administrators
6	Must-Have (Basic Needs)	<p>User-Friendly Interface</p> <ul style="list-style-type: none"> - Intuitive and user-friendly interface - Minimal training required for users
7	Must-Have (Basic Needs)	<p>Integration</p> <ul style="list-style-type: none"> - Compatibility with other educational systems and platforms - Integration with existing school infrastructure
8	Must-Have (Basic Needs)	<p>Customisation</p> <ul style="list-style-type: none"> - Flexibility to adapt the system to the specific needs of the school

9		<p>Performance</p> <ul style="list-style-type: none"> - System responsiveness and speed, even with a large number of concurrent users - Quick retrieval of results and reports
10	Performance Needs (Satisfiers)	<p>Reliability</p> <ul style="list-style-type: none"> - High system availability (minimal downtime) - Data integrity and accuracy
11		<p>Scalability</p> <ul style="list-style-type: none"> - Ability to handle increased data volume over time - Ability to accommodate a growing number of students and records
12		<p>Security</p> <ul style="list-style-type: none"> - Protection against data breaches and unauthorized access - Regular security updates and patches
13		<p>Usability</p> <ul style="list-style-type: none"> - Intuitive and user-friendly interface - Minimal training required for users
14		<p>Data Security</p> <ul style="list-style-type: none"> - Encryption of sensitive data - Access control to prevent unauthorized data tampering - Compliance with data protection regulations
15	Excitement Needs (Delighters)	<p>Compliance</p> <ul style="list-style-type: none"> - Adherence to local and international data protection laws - Compliance with educational standards
16		<p>Compatibility</p> <ul style="list-style-type: none"> - Cross-browser and cross-platform compatibility - Integration with existing school infrastructure
17		<p>Maintenance</p> <ul style="list-style-type: none"> - Ease of system updates and maintenance - Availability of technical support

18		Multi-Language Support: Language support based on context.
19	Indifferent Needs	Integration with Other Systems: Depends on specific requirements or demands.
20		Complicated Payment Process: Avoid hindering user experience.
21	Reverse Needs (Undesirable needs)	Manual Report Generation: Tedious, time-consuming report creation.
22		Inaccurate Result Processing: Crucial to maintain user trust.

This strategic planning process laid the groundwork for developing an effective and user-centric Automated Student Result Management System tailored to the specific needs of secondary schools in the Nigerian Education Sector.

5.4. Systems Design

In the system design phase for the Automated Student Result Management System, meticulous planning encompasses the user-facing, front-end and underlying back-end architecture. Key documentation pieces include the use case diagram, use case description, class diagram, ER diagram, and flowchart.

The use case diagram concisely overviews system functionalities, illustrating user interactions (Beimel & Kedmi-Shahar, 2019). The accompanying use case description delves into specific user roles, sequences of actions, and expected outcomes. The class diagram captures essential entities and their relationships, defining system structure (Altoyan & Batory, 2023). The ER diagram elucidates entity relationships, offering insights into interconnected elements (Hijazi et al., 2023). A flowchart visually maps logical process flows, outlining sequential steps in tasks (Xinogalos, 2013).

These documents collectively model crucial aspects, identifying users, defining interactions, and illustrating system structure and collaboration. The documentation ensures alignment with research objectives, laying a robust foundation for subsequent development phases. These design artifacts facilitate a comprehensive understanding of the Student Result Management System, fostering effective communication and clarity throughout development.

5.4.1. Use Case Diagram

The use case diagram outlines the interactions between different actors and the system. This visual representation helps illustrate how users, or actors, interact with the system, showcasing the various functionalities provided by the application. In the initial stage of problem formulation and identification of user requirements, a model is constructed based on real-world objects. The analysis focuses on how the system should function and how it needs to be developed to meet the specific needs of Anchor Group of Schools and possibly secondary schools in Nigeria.

The user functional input requirements are categorized into six main modules, aligning with the educational context:

- a. Students User Requirement Module: Describing the specific needs and interactions of students with the system. This involves functionalities related to accessing their results, tracking academic progress, and other student-specific requirements.
- b. Teachers User Requirement Module: This module details the requirements and interactions of teachers within the system, including tasks related to result entry, grading, and communication with students.
- c. Parents User Requirement Module: Outlines the functionalities that parents require, such as accessing their child's results, receiving updates on academic performance, and communicating with teachers.
- d. Data Entry Officer (Administrator I) User Requirement Module: Functionalities related to exam management and record-keeping are involved here. This involves tasks related to system configuration, user roles, and ensuring the system's smooth operation.

- e. Principal (Administrator I) User Requirement Module: Outlines functionalities related to ensuring accurate grades, endorsing reports, generating insights, granting approvals and safeguarding sensitive student data through security and access control.

The use case diagram is a crucial visual tool that provides an overview of how different actors in the secondary school context interact with the Automated Student Result Management System, ensuring that the system is tailored to meet the unique needs of the Nigerian educational sector at the secondary school level.

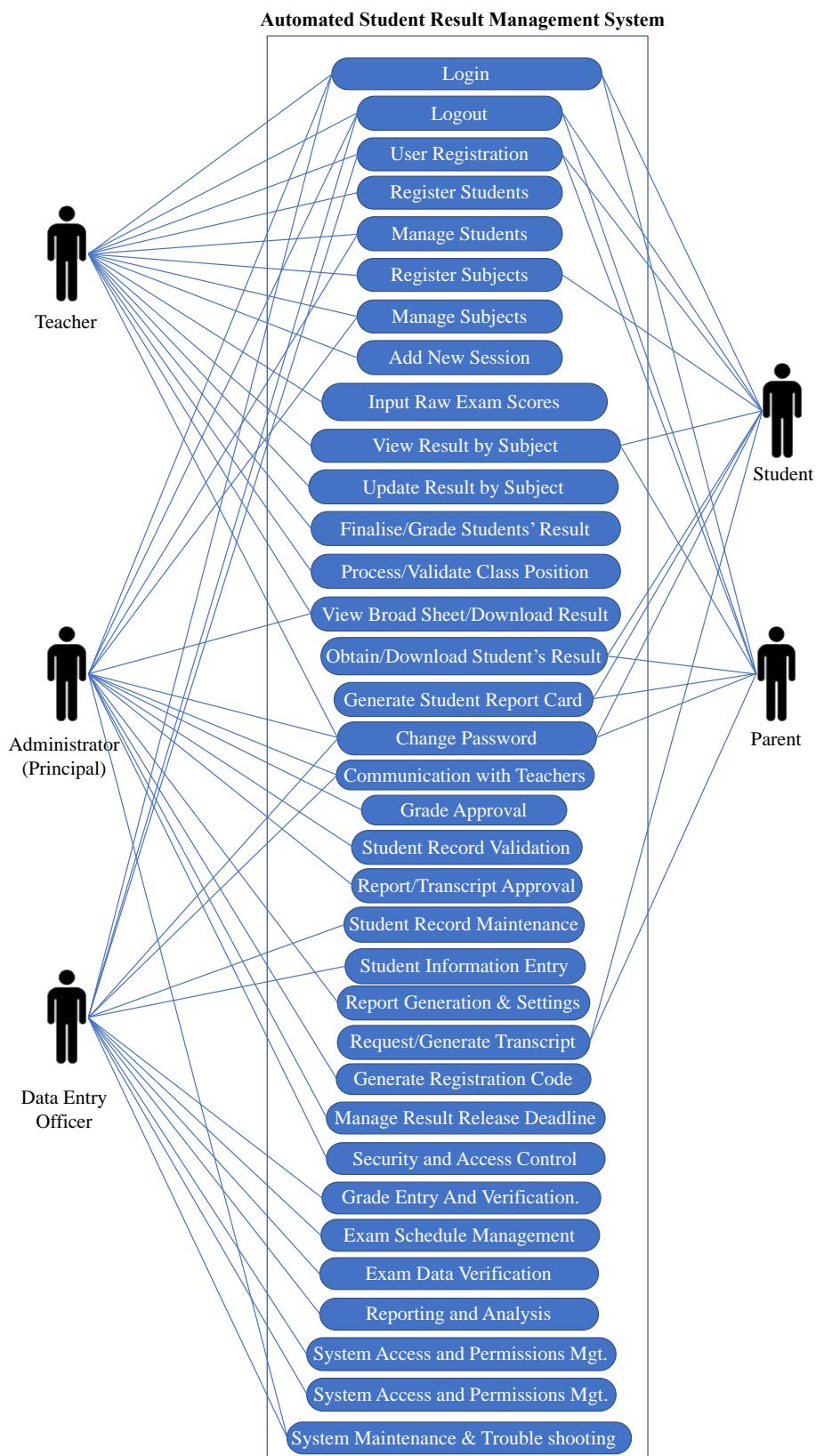


Figure 5.5: Use Case Diagram (Source: Akintunde, 2023)

5.4.2. Use Case Description

The tabulated use case description provided a thorough and detailed clarification of each use case, elucidating the specific steps and requirements necessary to execute each activity successfully. In the use case diagram above:

Actors:

- Teachers
- Students
- Parents
- Principal (Administrator I)
- Data Entry Officer (Administrator II)

5.4.2.1. Use Case 1: Sign Up, Viewing and Retrieving Academic Results

Description: This use case empowers stakeholders to register accounts by inputting their pertinent personal details. The functionality ensures a smooth and accessible account creation process tailored for users in an educational setting.

Table 5.3: The Proposed Use Case Description for all actors.

Actor	Parent/Student/Teacher/Administrator (Principal)
Flow	<ul style="list-style-type: none">• The user visits the homepage.• The user clicks on the register button to sign up.• The user inputs their name, email address, and password to create an account.• After providing the necessary information, the user clicks the register button to complete the registration.• The system stores the user's information in the database.• The user is redirected to the login page for subsequent access to the system.

5.4.2.2. Use Case 2: Student Access and Academic Result Management

Description: The use case delineates the sequence of actions involved when a student accesses and manages their academic results through the application system.

Table 5.4: The Proposed Use Case Description for Student

Actor	Student
Flow	<ul style="list-style-type: none">• The student accesses the application through their designated portal.• The student navigates to the "Results" section to view their academic performance.• The system displays the available options, allowing the student to choose a specific academic term or examination.• Upon selection, the system retrieves and presents the student's results for the chosen term or examination. The student has the option to download or print the displayed results for record-keeping purposes.• The system ensures data security and privacy, allowing access only to the authorised student.• The student securely logs into the application using their designated credentials via the student portal.• The student can securely log out of the system when done, ensuring data privacy and preventing unauthorised access.• The system allows new students to register by providing the necessary information and creating a secure account for future logins.• The student can register for specific subjects within the system, aligning their academic profile with the subjects offered in the school.• After logging in, the student can navigate to the "Results" section and choose to view academic results for specific subjects.• The system retrieves and presents the student's results for the chosen term or examination. The student has the option to download or print the displayed results for record-keeping.• The student can generate a comprehensive report card summarizing their academic performance across subjects and terms.• As a security measure, the system allows the student to change their password periodically, enhancing the overall protection of sensitive information.• The student can request or generate an academic transcript within the system, providing a detailed record of their academic achievements.

5.4.2.3. Use Case 3: Parental Access to the Student Result Management System

Description: This use case outlines the step-by-step process a parent follows when accessing and overseeing their child's academic results through the Automated Student Result Management System (ASRMS).

Table 5.5: The Proposed Use Case Description for Parents

Actor	Parents
Flow	<ul style="list-style-type: none"> The parent logs into the system using their designated credentials via the secure portal. Within the parent dashboard, the system provides a clear pathway to the "Results" section for a comprehensive view of their child's academic performance. The system displays available options, enabling the parent to choose a specific academic term or examination for detailed insights. Upon selection, the system retrieves and presents the student's results for the chosen term or examination, ensuring parents have access to accurate and up-to-date information. The parent is given the option to download or print the displayed results, facilitating easy record-keeping and sharing with relevant stakeholders. As an added feature, the system allows parents to generate a comprehensive report card summarizing their child's academic performance across subjects and terms. To ensure data security and privacy, the parent can securely log out of the system, preventing unauthorized access and maintaining confidentiality. Parents have the capability to manage their accounts, including the ability to register, update information, and ensure the accuracy of their credentials. As a security measure, the system enables parents to change their passwords periodically, enhancing the overall protection of sensitive information. For a more detailed analysis, parents can explore individual subjects to gain insights into their child's performance in specific academic areas. In addition to viewing results online, parents can download a copy of their child's results for offline access or archiving purposes. The parent can request or generate an academic transcript on behalf of their wards within the system, providing a detailed record of their academic achievements.

5.4.2.4. Use Case 4: Teachers Access to the Student Result Management System

Description: This use case outlines the step-by-step process a teacher follows when accessing and overseeing their students' academic results through the Automated Student Result Management System (ASRMS).

Table 5.6: The Proposed Use Case Description for Teachers

Actor	Teachers
Flow	<ul style="list-style-type: none"> • The teacher logs into the system using their designated credentials via the secure portal. • After logging in, the teacher can navigate to the "Results" section to assess the academic performance of students. • The system displays various options, allowing the teacher to choose a specific academic term or examination for detailed insights into student performance. • Upon selection, the system retrieves and presents the student's results for the chosen term or examination, providing teachers with a comprehensive overview. • Teachers are given the option to download or print the displayed results for record-keeping purposes. • The system ensures data security and privacy, allowing access only to authorised teachers for effective management of student information. • Teachers can securely log out of the system when their tasks are completed, maintaining the integrity of the data. • The system provides features for user registration, allowing teachers to create and manage their accounts securely. • Teachers have the ability to register students, facilitating the systematic organisation of student data within the ASRMS. • The system allows teachers to manage students, ensuring accurate and up-to-date information is maintained throughout the academic session. • Teachers can register subjects within the ASRMS, aligning the system with the specific subjects offered in the school. • Subject management features enable teachers to organise and update subject-related information within the ASRMS efficiently. • Teachers can add a new session, ensuring that the ASRMS is current and aligned with the ongoing academic year. • Inputting raw exam scores is facilitated within the system, streamlining the process of recording and managing student performance data. • Teachers can view results by subject, gaining insights into individual student performance across various academic areas. • Updating results by subject is a feature that allows teachers to make necessary adjustments to student scores as needed. • The system facilitates the finalisation and grading of students' results, ensuring accuracy and consistency in the assessment process.

	<ul style="list-style-type: none"> Teachers can process and validate class positions, allowing for the accurate determination of students' academic standing within their class. Viewing the broadsheet and downloading results is made easy through the system, providing teachers with a comprehensive overview of student performance. Teachers have the option to change their passwords, enhancing the security of their accounts within the ASRMS.
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5.4.2.5. Use Case 5: Data Entry Officer (Administrator I) Access, Processing and System Administration.

Description: This use case details the series of actions undertaken by a Data Entry Officer (Administrator I) when accessing and processing students' academic results through the Automated Student Result Management System (ASRMS).

Table 5.7: The Proposed Use Case Description for Data Entry Officer (Administrator I)

Actor	Data Entry Officer (Administrator I)
Flow	<ul style="list-style-type: none"> The data entry officer logs into the system using their designated credentials via the secure portal. After logging in, the officer enters the "Results" section to facilitate the input and verification of academic performance data. The system displays various options, allowing the officer to choose a specific academic term or examination for streamlined data entry. Upon selection, the system retrieves and presents the student's results for the chosen term or examination, providing the officer with a data entry interface. The officer can facilitate the download or printing of the displayed results for record-keeping purposes and communication with relevant stakeholders. The system ensures data security and privacy, permitting access only to authorised data entry officers for efficient management of student information. The data entry officer can securely log out of the system when their tasks are completed, maintaining the integrity of the data. The system provides features for user registration, allowing the officer to create and manage their account securely. Officers are responsible for maintaining student records and ensuring accuracy and completeness throughout the academic session.

	<ul style="list-style-type: none"> The officer enters and verifies student information, ensuring that the system is updated with the latest data. Grade entry and verification are integral tasks, ensuring that accurate and consistent grading information is recorded. The officer manages exam schedules within the system, ensuring alignment with the school's academic calendar. Verification of exam data is a crucial step, ensuring the accuracy and completeness of the information entered into the system. Reporting and analysis features allow the officer to generate insights from the data, facilitating informed decision-making. The officer communicates with teachers for clarification and additional information related to student performance. The system supports the approval of grades, providing a structured process for ensuring the accuracy of recorded grades. System access and permission management features enable the officer to control and monitor access levels for different system users. The officer plays a role in the routine maintenance and troubleshooting of the system to ensure optimal functionality.
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5.4.2.6. Use Case 6: Principal (Administrator II) Oversight of Academic Results and Systems

Administration

Description: This use case details the series of actions undertaken by a Principal (Administrator II) when accessing and processing students' academic results through the Automated Student Result Management System (ASRMS).

Table 5.8: The Proposed Use Case Description for Principal (Administrator II)

Actor	Principal (Administrator II)
Flow	<ul style="list-style-type: none"> The principal logs into the system using their designated credentials via the secure portal. After logging in, the principal can navigate to the "Results" section to review students' academic performance. The system displays various options, allowing the principal to choose a specific academic term or examination for a detailed examination of student performance. Upon selection, the system retrieves and presents the student's results for the chosen

	<p>term or examination, providing the principal with a comprehensive overview.</p> <ul style="list-style-type: none"> • The principal can download or print the displayed results for record-keeping and communication with relevant stakeholders. • The system ensures data security and privacy, allowing access only to the authorised principal for effective student information management. • The system provides features for user registration, allowing the principal to create and manage their account securely. • Principals can manage student records, ensuring accurate and up-to-date information is maintained throughout the academic session. • Subject management features enable principals to organise and oversee subject-related information within the ASRMS efficiently. • Principals can view results by subject, gaining insights into individual student performance across various academic areas. • Communication with teachers is facilitated within the system, allowing the principal to engage with educators regarding student performance and related matters. • The system supports the approval of grades, ensuring consistency and accuracy in the assessment process. • Principals oversee the validation of student records, ensuring the integrity and completeness of academic data. • Approval of reports and transcripts is a crucial responsibility, allowing the principal to ensure the accuracy and reliability of official documents. • The system supports generating and customising reports, including settings for specific report formats and content. • Principals can generate registration codes for various academic and administrative purposes within the ASRMS. • The system allows principals to manage result release deadlines, ensuring timely and organised dissemination of student performance information. • Security and access control features are integrated to maintain the confidentiality and integrity of student data, limiting access to authorized personnel.
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5.4.3. Functional Decomposition of the Automated Student Result Management System

Functional decomposition breaks down a system into its core functions, facilitating a detailed understanding of its components (Brimhall et al., 2016; Dixit, 2007; Gray et al., 2015). In alignment with the research topic, this functional decomposition emphasises the segregation of activities between students and staff as depicted in Figure 5.6. The diagram underscores the seamless flow of tasks among administrators, teachers, parents, students, and the result system, ensuring efficient and targeted access. The modular design significantly enhances overall management and performance evaluation processes in secondary schools.

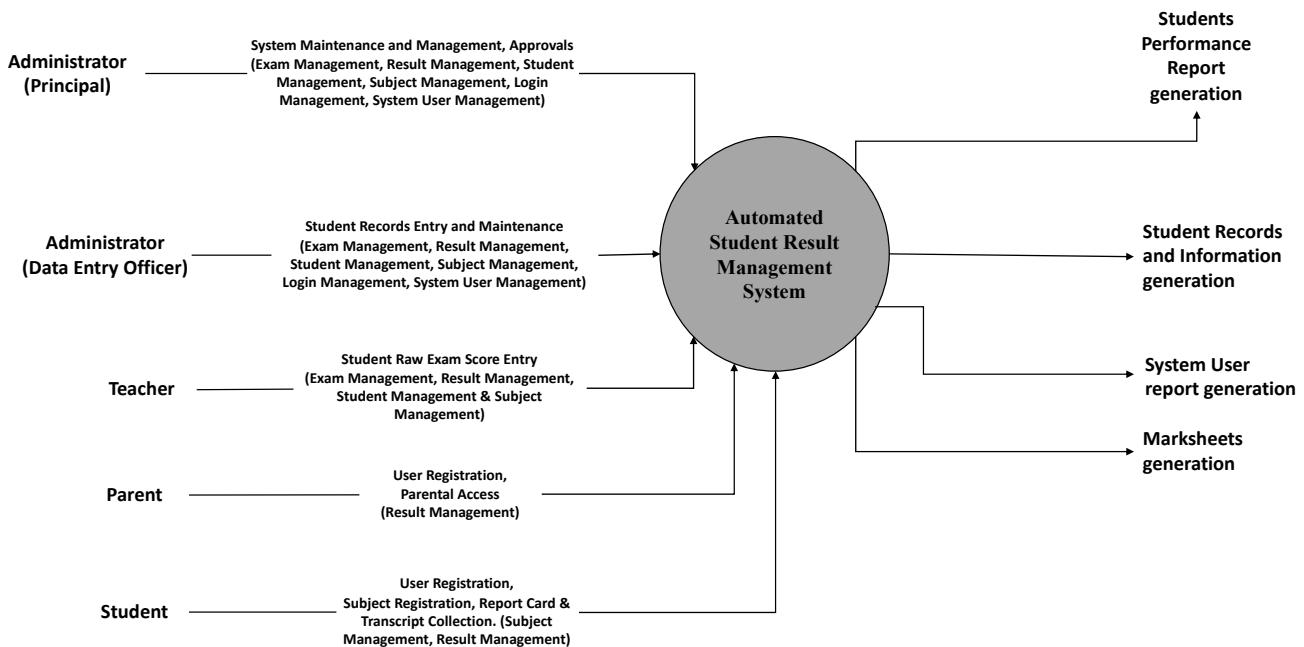


Figure 5.6: The contextual diagram for the ASRMS, illustrating the interconnected roles and functionalities (Source: Akintunde, 2023).

With distinct portals for student and staff management, they are addressing the needs of both user groups effectively. The student management portal grants access to Students and their parents, allowing them to view all things related to their results while the staff management portal contains activities carried out by

teachers, Data Entry Officer (Administrator I), and Principal (Administrator II). Teachers play a pivotal role in handling student results, while the Principal and Data Entry Officer serve as systems administrators, holding the highest access privileges and responsibilities.

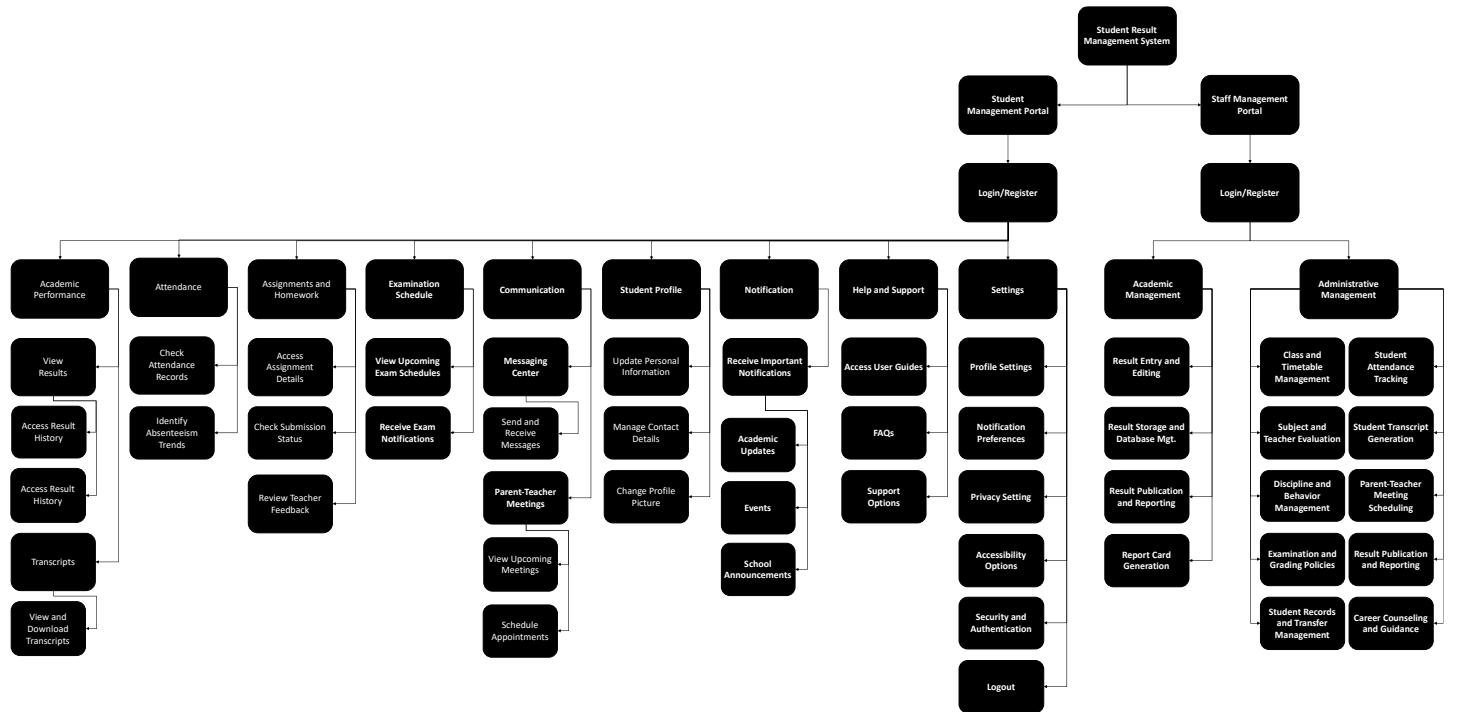


Figure 5.7: Functional Decomposition of the system (Source: Akintunde, 2023)

5.4.4. System Process Overview

The Automated Student Result Management System (ASRMS) streamlines processes for secondary schools for efficient result management. Users, including teachers, principal (administrator II), data entry officer (administrator I), parents, and students, register and log in securely. System administrators (the principal and data entry officer) configure settings and manage subjects. Teachers enter and validate results, with the principal and data entry officer overseeing moderation and approval. Students and parents access results, while administrators (principal and data entry officer) generate reports, manage and approve transcripts. The user communication facilitates interaction, and security measures ensure data integrity. System monitoring and maintenance by administrators ensure optimal

performance, creating a comprehensive, organised, and collaborative framework for effective student result management.

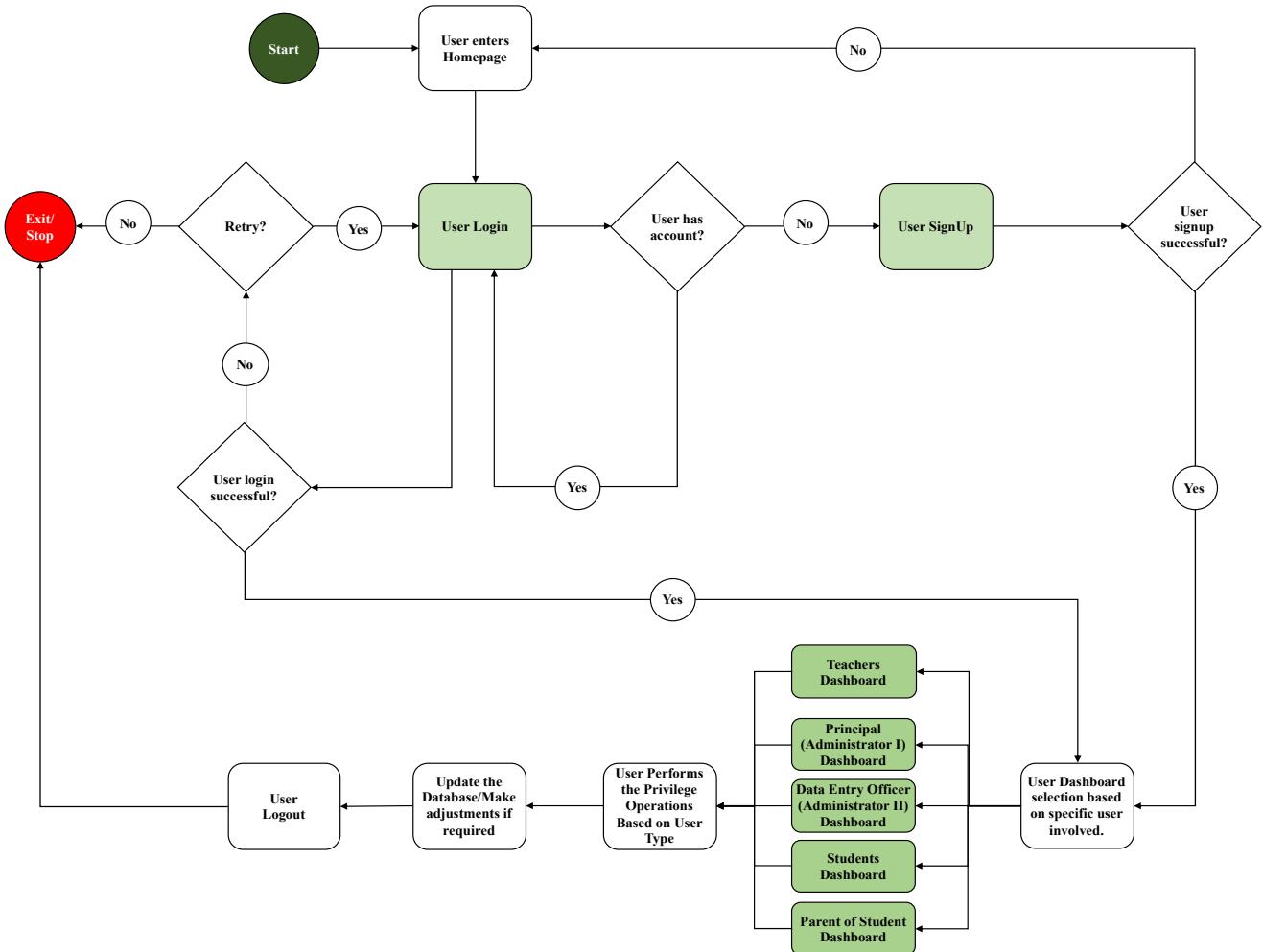


Figure 5.8: The Proposed System Overview (Source: Akintunde, 2023)

It is important to note that the system will be accessible through both a web application and a mobile application. These platforms have been designed to ensure ease of access and user convenience, enabling users to interact with the system anytime and anywhere globally. The prototype for the web application was created using Figma, but it did not progress to the development stage due to time constraints on the project and a delay in user acceptance. On the other hand, the mobile application has been fully developed and is ready for deployment on Google Play.

Web Application Prototype Link: (See Appendix M for Screenshots)

<https://www.figma.com/file/GcebcDEZYUTgooAmpleOKV/iResultlab---Web?type=design&node-id=32%3A64&mode=design&t=gIYWTaa1xrcqw6cH-1>

Mobile Application Design Link:

<https://www.figma.com/file/qzBYrVbFzh5LRMiDCcYB0V/iResultlab---Mobile?type=design&node-id=0%3A1&mode=design&t=tFdoLAapFW5x9Lfe-1>

Mobile Application Link (See Appendix L): <https://github.com/akintunde07/Dissertation>

5.4.4.1. Student Management Portal

The student management portal, dedicated to students and parents emphasises the exclusive access for students, focusing on activities like user registration, subject registration, viewing results by subject, obtaining/downloading students' results, generating students' report cards, changing passwords, and requesting/generating transcripts.

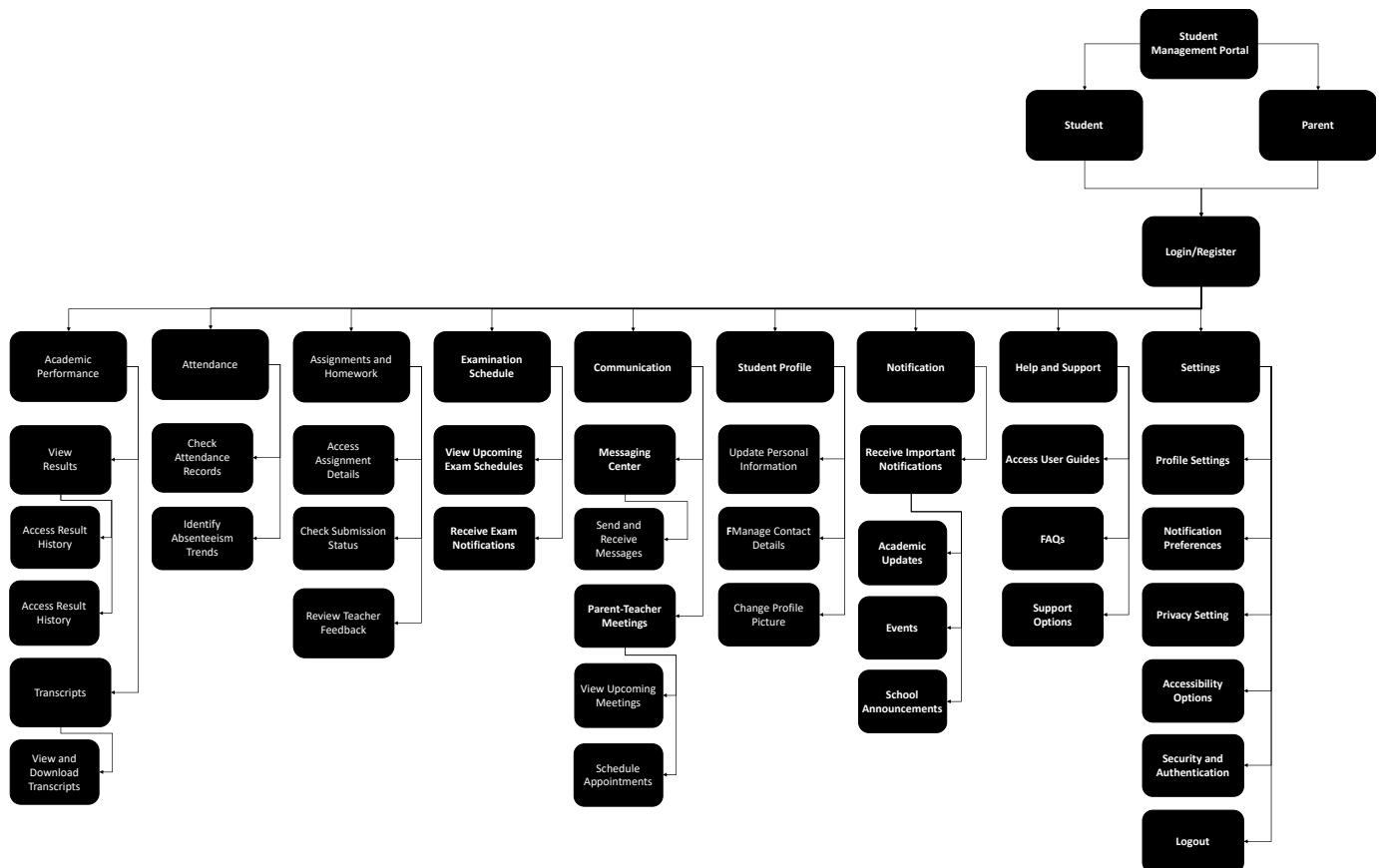


Figure 5.9: Functional Decomposition of the Student Management Portal of the Proposed System

(Source: Akintunde, 2023)

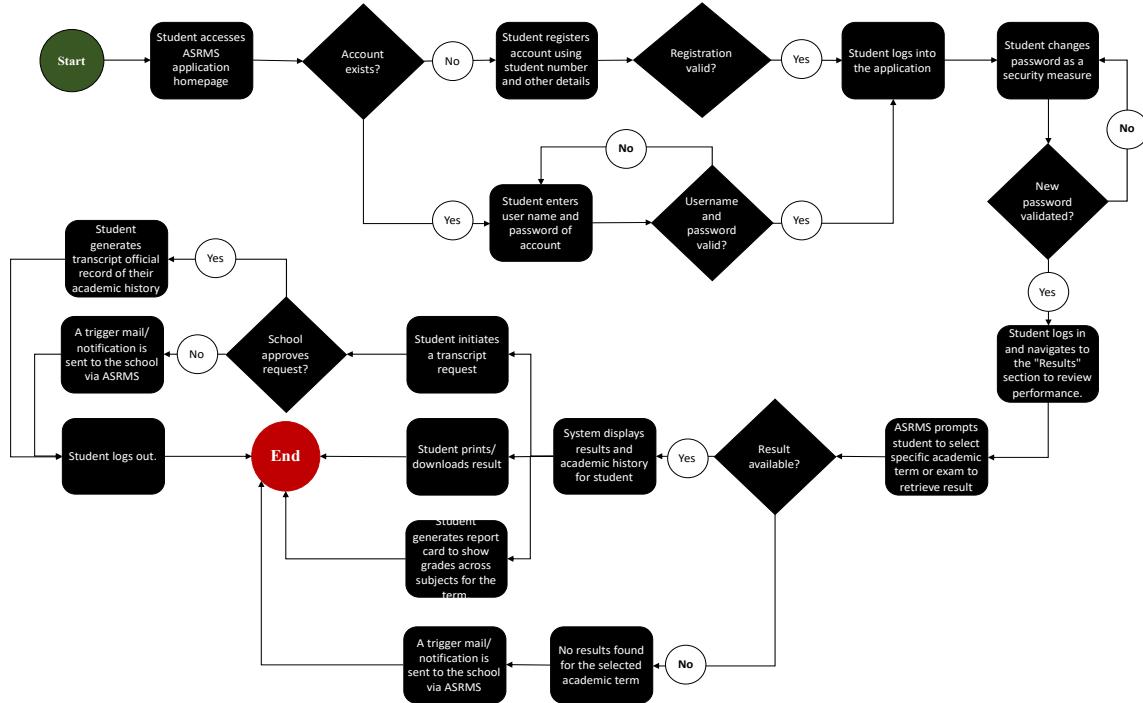


Figure 5.11: Basic activities of students on the Proposed System (Source: Akintunde, 2023)

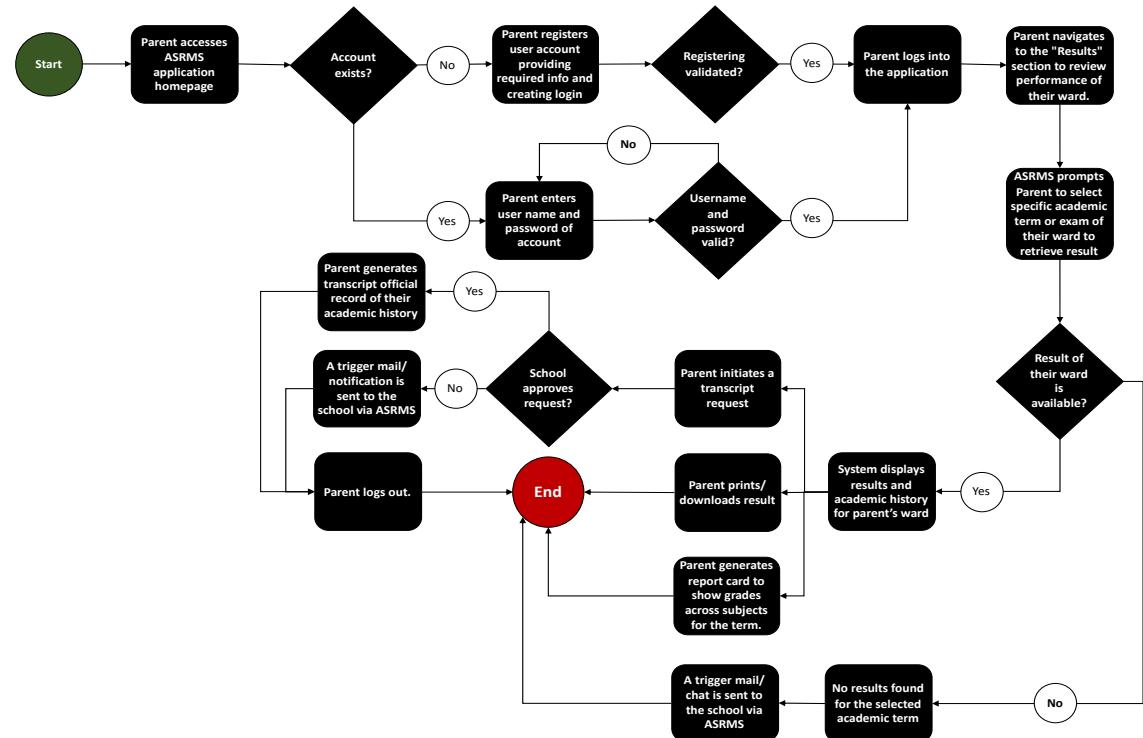


Figure 5.12: Basic activities of parents on the Proposed System (Source: Akintunde, 2023)

5.4.4.2. Staff Management Portal

The staff management portal caters to teachers and administrators. Teachers are saddled with effective academic management on the portal, while the administrators have total oversight on the administrative aspect of managing the system. Administrator I, the Data Entry Officer, handles data input and is saddled with the daily operational efficiency of the system, while Administrator II, the Principal, oversees overall school management, ensuring approvals are granted when and where required and reviewing of student performance. Features include user management, report generation, and administrative functions for seamless school operations.

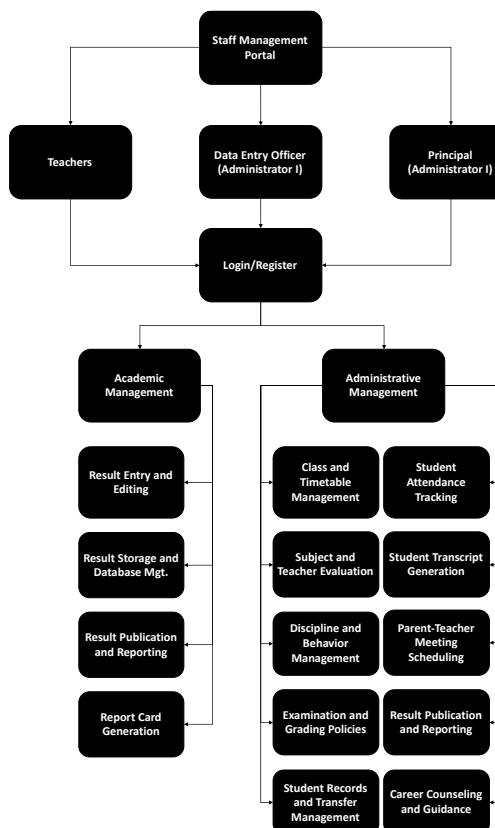


Figure 5.13: Functional Decomposition of the Staff Management Portal of the Proposed System
(Source: Akintunde, 2023)

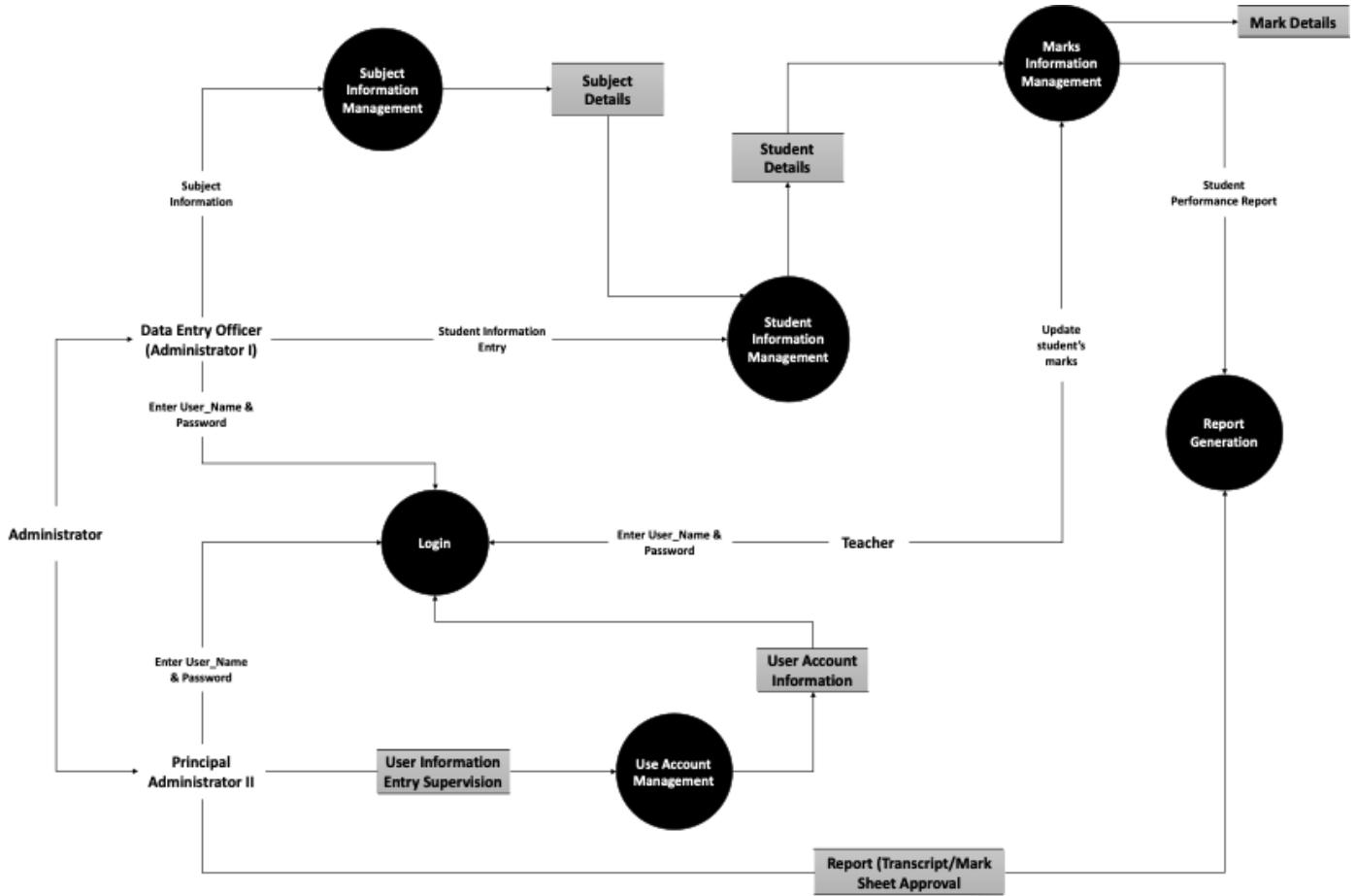


Figure 5.14: Data Flow Diagram (DFD) of Operational Activities of Staff (Source: Akintunde, 2023)

5.4.4.3. User Registration and Login Module

The Automated Student Result Management System for Nigerian Secondary Schools features a secure and user-friendly registration and login module. Users, including staff and students, register with institutional emails and secure passwords. A future security outlook is a proposed security enhancement involving a registration code sent to staff emails for added authentication. This strict security measure will contribute significantly to safeguarding sensitive educational data. Figure 4.1.3 illustrates the registration and login steps, emphasising the system's commitment to reliability and security. The accompanying Data Flow Diagram (DFD) visually outlines seamless data flow, providing a clear overview of operational dynamics within the system.

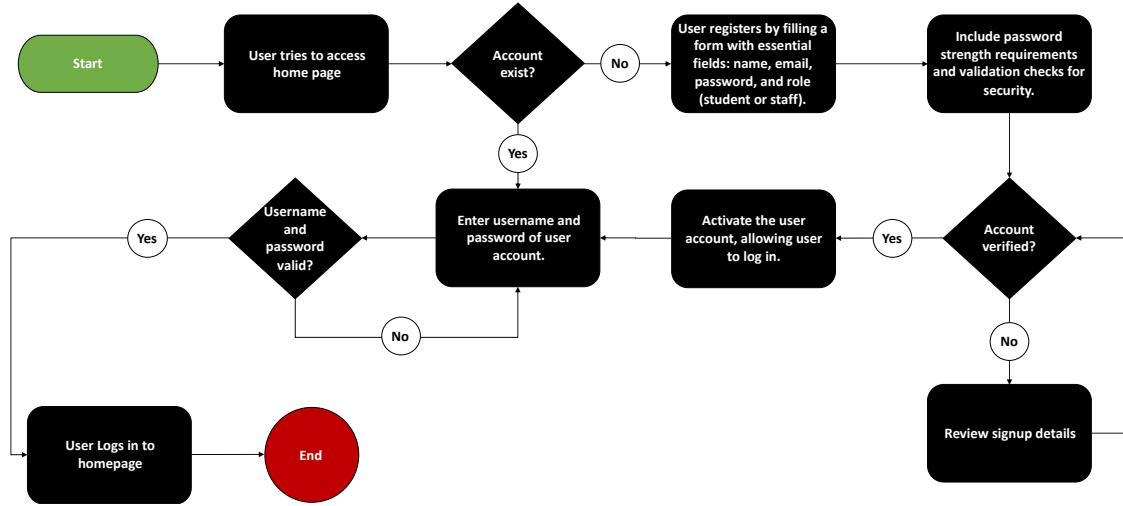


Figure 5.15: User Registration and Login Module (Source: Akintunde, 2023)

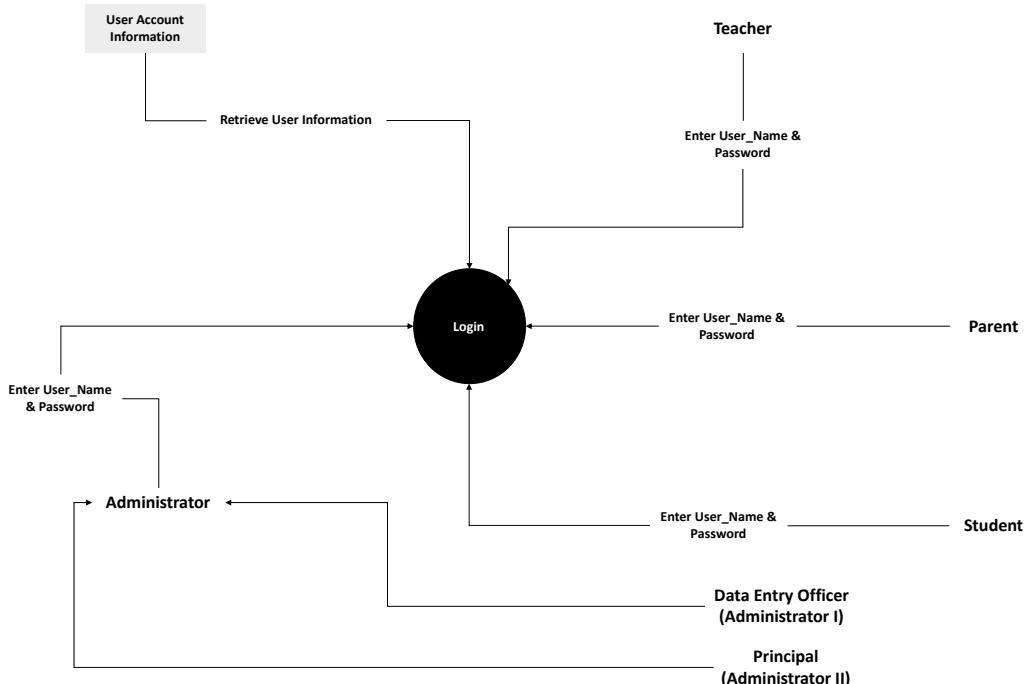


Figure 5.16: Data Flow Diagram for User Registration and Login Module (Source: Akintunde, 2023)

5.4.5. User Account Maintenance

The Automated Student Result Management System facilitates user account maintenance, encompassing report generation, user information display, and data validation. This streamlined process

empowers administrators to generate insightful reports, access detailed user information securely, and validate user data. In the system architecture, the Data Entry Officer oversees these tasks, ensuring efficient user account operations. Furthermore, the Principal conducts weekly reviews of the Data Entry Officer's actions, enhancing oversight, accountability, and maintaining the system's integrity.

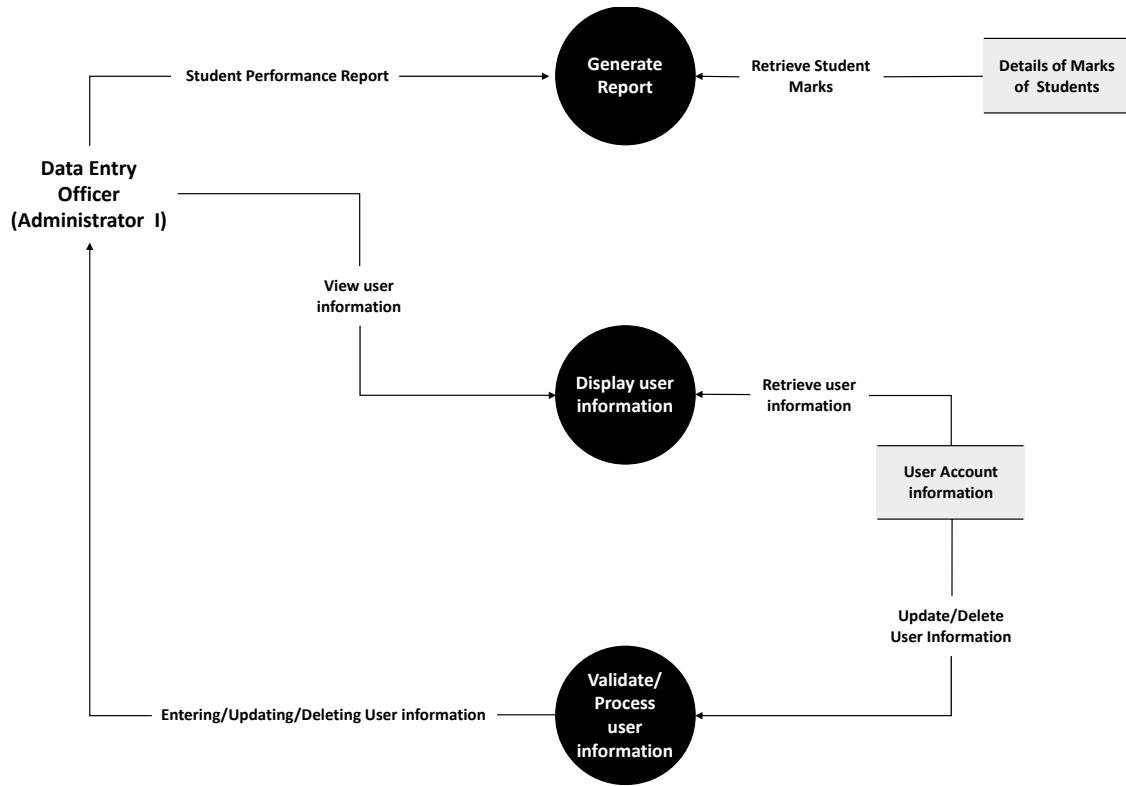


Figure 5.17: Data Flow Diagram for User Account Maintenance (Source: Akintunde, 2023)

5.4.6. Management of Student and Subject Information

In the Automated Student Result Management System, the Data Entry Officer is responsible for managing both student information and subject information. This includes tasks such as entering and updating student details, handling subject-related data, and ensuring the accuracy and completeness of information in the system. The Data Entry Officer plays a crucial role in maintaining the integrity of student and subject data, contributing to the effective functioning of the system and providing reliable results for educational stakeholders.

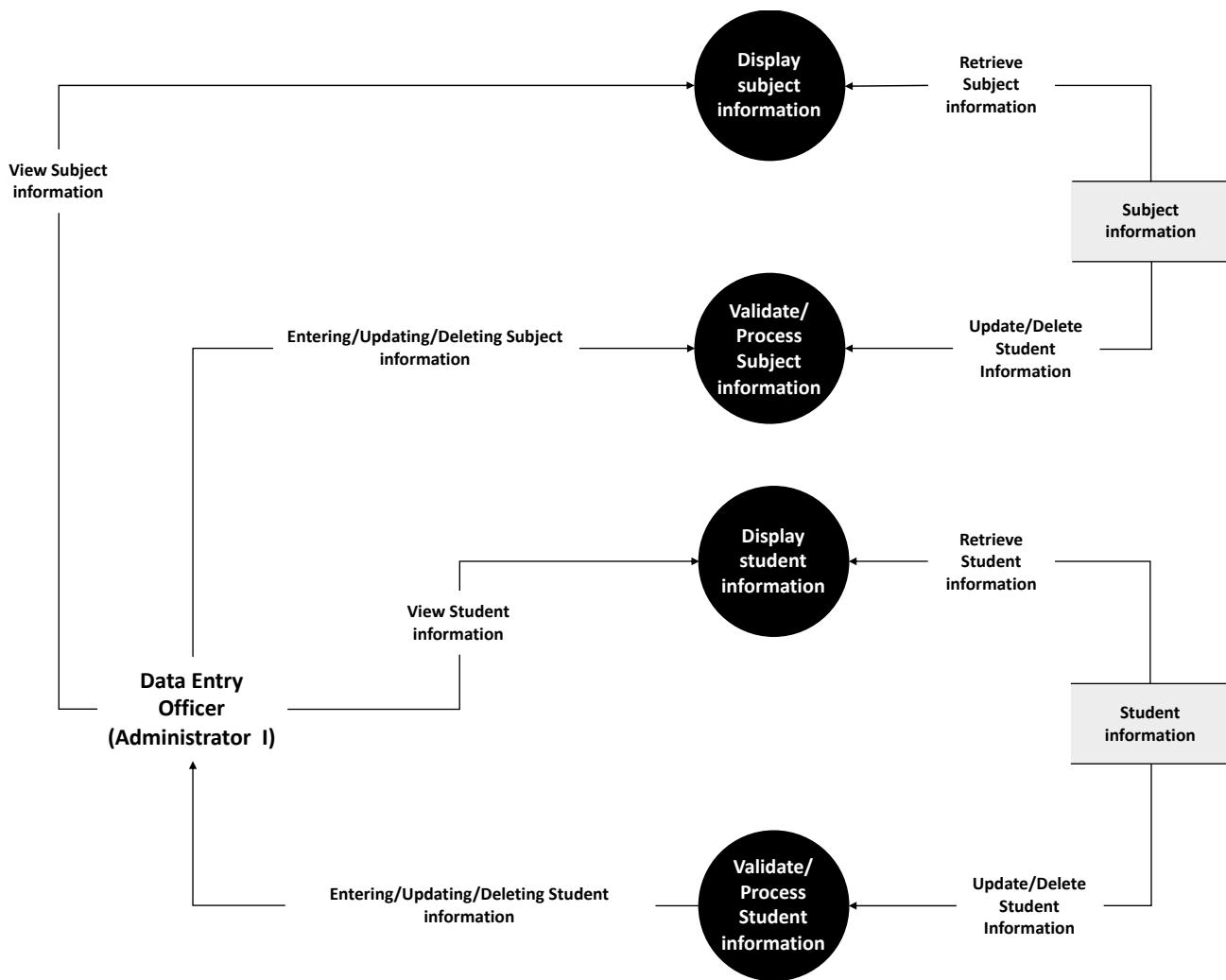


Figure 5.18: DFD for Managing Student and Subject Information (Source: Akintunde, 2023)

5.4.7. Marksheets Information Management

In the Automated Student Result Management System, students securely access their marks, teachers input and update subject marks, and the Data Entry Officer oversees comprehensive marks information management. Validating and processing data, the officer ensures accuracy and generates reports submitted for approval to the Principal. This coordinated effort streamlines the process, ensuring efficient academic information management within the system.

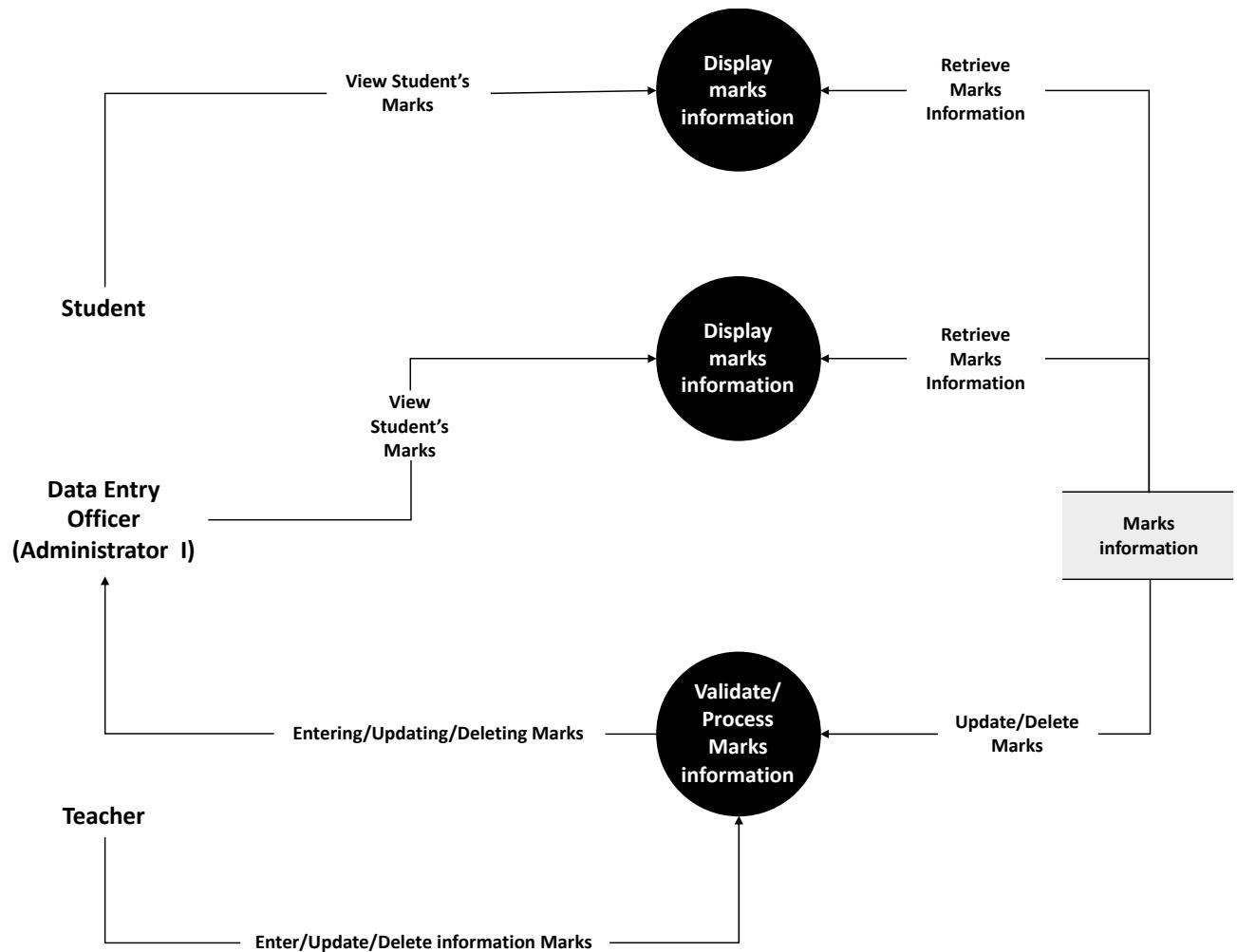


Figure 5.18: DFD for Mark Information Management (Source: Akintunde, 2023)

5.5. Class Diagram and Entity Relationship (ER) Diagram

5.5.1. Class Diagram

The Class Diagram for the Automated Student Result Management System (ASRMS) serves as a foundational blueprint outlining the system's structure and relationships among critical entities. In this context, classes represent fundamental entities such as Students, Teachers, Subjects, Parents, Data Entry Officer, Principal, and Results. Associations between these classes illustrate the connections and interactions within the ASRMS.

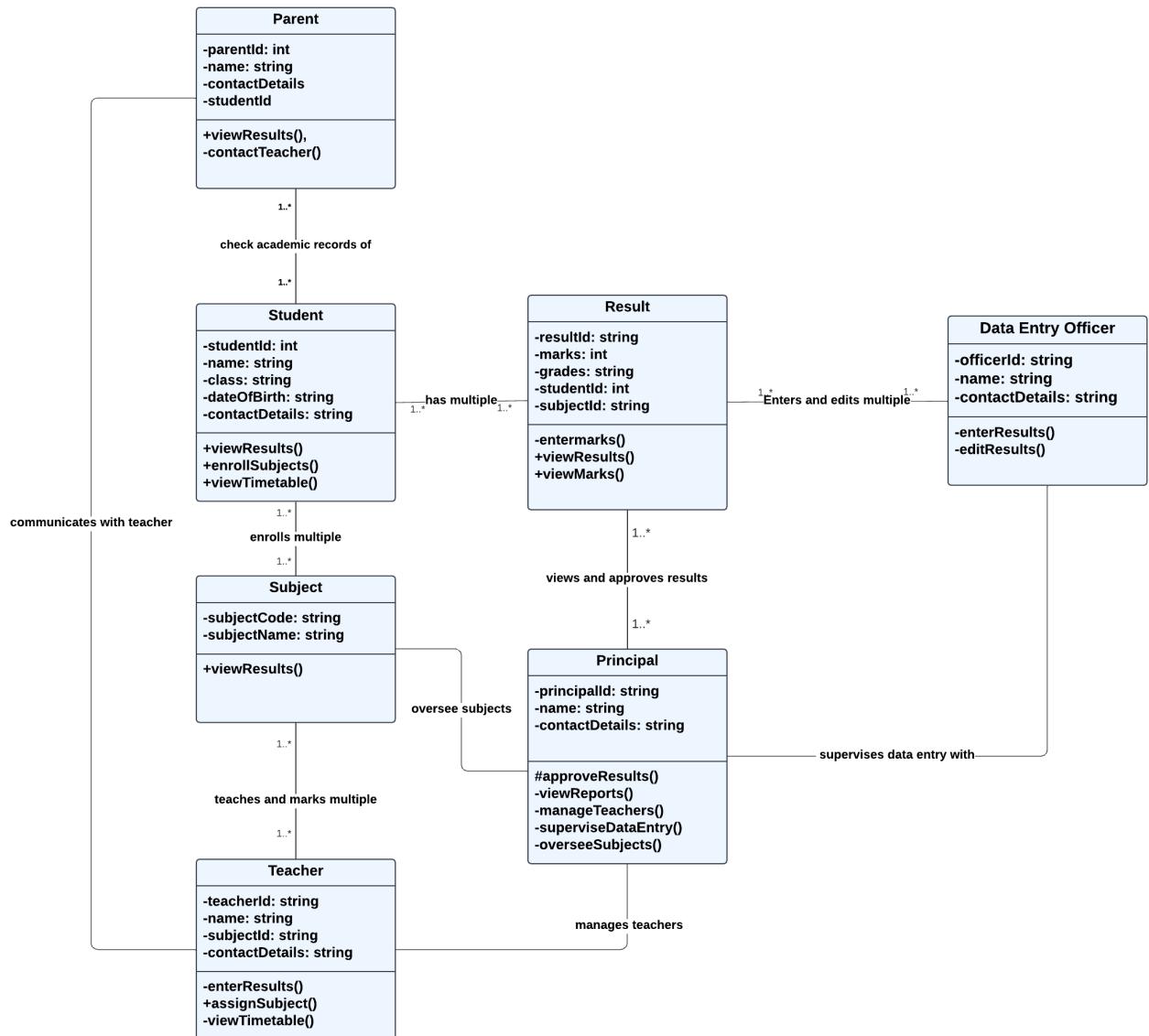


Figure 5.19: The Proposed Class Diagram (Source: Akintunde, 2023)

These classes and their relationships form a comprehensive framework for designing and implementing the ASRMS, ensuring a clear representation of data flow and system behaviour.

5.5.2. Entity Relationship (ER) Diagram

In the context of developing an Automated Student Result Management System (ASRMS), the Entity Relationship (ER) Diagram plays a pivotal role in refining the system's structure. Key entities such as

Student, Teacher, Principal, Data Entry Officer, Subject, Result, and Parent are meticulously defined, each having its unique set of attributes and relationships.

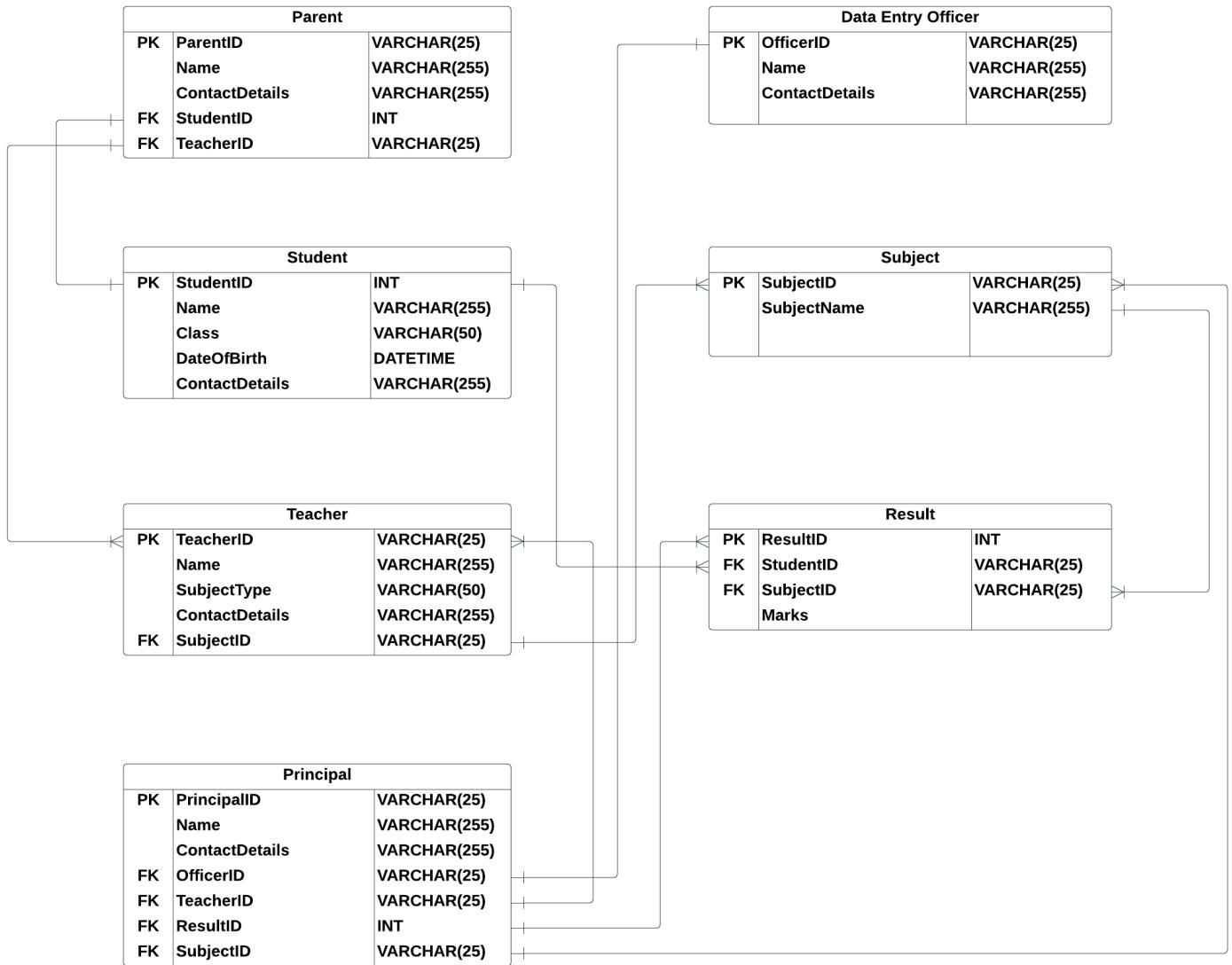


Figure 5.20: The Proposed ER Diagram (Source: Akintunde, 2023)

The ER Diagram visually represents the database schema, offering insights into how data is stored and interconnected within the ASRMS. This structured approach ensures the system's scalability, efficiency, and maintainability, aligning with the specific needs of the Nigerian Education Sector.

To address the software architectural design for the ASRMS, especially within the Nigerian Education Sector, the Microservices Architecture is recommended. Baškarada et al. (2018, p.3) posit that this

architectural paradigm promotes modularity, flexibility, and scalability. It aligns well with the dynamic and evolving nature of educational systems, allowing for independent development and deployment of services, ultimately enhancing the overall effectiveness of the ASRMS.

5.6. Software Architecture Design

Baabad et al. (2022) assert that thoughtfully crafted architecture plays a pivotal role in fostering modularity, scalability, maintainability, and robustness. The design of the new system encompasses the arrangement and structuring of its components, modules, and interactions, aiming to achieve its objectives efficiently and effectively.

Selecting an appropriate software architectural design is paramount for the effectiveness, scalability, and maintainability of the Automated Student Result Management System (ASRMS) in the Nigerian Education Sector. Given the specific requirements and objectives of the ASRMS, the recommended choice is the microservices architecture.

In the microservices architectural approach, the system is partitioned into small, autonomous, and modular services, each tasked with a specific business capability. According to Fowler and Lewis (2014), microservices involve developing a single application as a collection of small services, each operating in its independent process and communicating through lightweight mechanisms, often an HTTP resource API. These services are designed around distinct business functionalities and can be deployed independently through automated deployment processes. This contemporary architectural style facilitates the construction of large, intricate, and scalable applications composed of small, self-contained processes that interact with each other using APIs (Kratzke, 2015). The microservices architecture aligns seamlessly with the diverse functionalities of the ASRMS and offers numerous advantages.

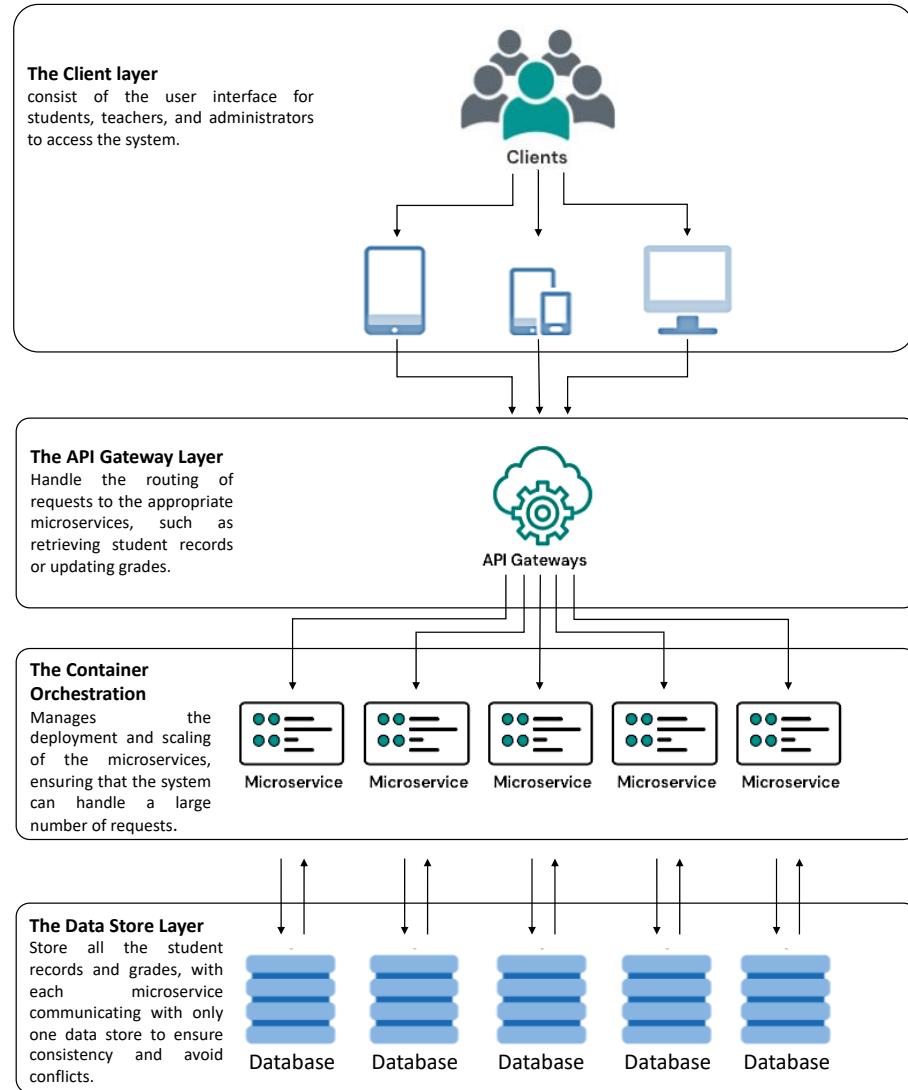


Figure 5.21: Microservices Architectural Design (Adapted from Suljkanović et al. 2022)

- **Scalability:** Microservices allow for independent scaling of services based on demand (Baškarada et al., 2018, p.1). In the context of the ASRMS, this enables scaling specific components, such as result processing or user authentication, to handle varying workloads effectively.
- **Modularity and Flexibility:** The modular nature of microservices facilitates independent development, deployment, and maintenance of each service. Baškarada et al. (2018) emphasised that this flexibility is crucial in accommodating changes or additions to the

system without disrupting the entire application.

- **Technology Diversity:** Microservices permit the use of different technologies for each service, enabling the selection of the most suitable technology stack for each specific functionality (Baškarada et al., 2018, p.5). This is beneficial in leveraging the strengths of various technologies and adapting to diverse requirements within the ASRMS.
- **Fault Isolation:** Since each service operates independently, a failure in one microservice does not necessarily impact the entire system (Baškarada et al., 2018, p.2; Suljkanović et al. 2022, p.5). This ensures better fault isolation and resilience.
- **Ease of Development and Deployment:** Microservices simplify the development process by allowing teams to work on different services simultaneously (Baškarada et al., 2018). Deployment is also more straightforward, as updates to one service do not require redeployment of the entire system (Suljkanović et al., 2022).
- **Integration and Interoperability:** Microservices can communicate through well-defined APIs, promoting better integration with external systems and enhancing interoperability (Suljkanović et al., 2022, p.4).

Considering the complexity and diverse functionalities of an Automated Student Result Management System, the Microservices Architecture provides a robust and scalable foundation, aligning well with the unique requirements of the Nigerian Education Sector.

5.7. System Development Architecture

Embarking on the development journey of the Automated Student Result Management System (ASRMS) involves a systematic and multi-stage process. This journey is meticulously designed to conceptualise, design, and implement an innovative solution, adhering to ideal standards for optimising result management operations and enriching user experience within the Secondary Schools in the Nigerian Education Sector. Below are the steps taken to achieve this feat:

5.7.1. Requirements Analysis

- **Defining Objectives:** The initial stage comprehensively outlines the goals, objectives, and scope of the ASRMS.
- **Functionalities Identification:** Key functionalities, user roles, and anticipated outcomes are delineated.
- **Stakeholder Mapping:** Identification of stakeholders, encompassing students, teachers, parents, principal and data entry officer.

5.7.2. User Requirements Gathering

- **Data Compilation:** Historical datasets are collected through stakeholder interviews and surveys, ensuring a holistic understanding of user needs and system requirements.
- **Data Preprocessing:** Data preprocessing tasks, such as handling missing values and duplicates, are performed using Microsoft Excel for efficient data cleaning and preparation.
- **User Engagement:** Stakeholder engagement is facilitated through online meetings and surveys, utilising modern web-based tools such as Google Forms and Zoom.

5.7.3. High-Level Architecture Design

- **Architectural Blueprint:** Development of a high-level architecture that meticulously defines the structure of the ASRMS, including the database design and integration points.
- **User Interface Prototyping:** The creation of wireframes and mockups ensures an intuitive and user-friendly interface for all stakeholders (i.e. students, teachers, parents, and administrators (principal and data entry officer)), enhancing overall user experience. Based on

analysis gathered from questionnaires and personal interactions, students and parents are expected to be more active on the mobile app. The web app will be more utilised at the staff level but they also have the opportunity to perform their activities on the mobile app.

5.7.4. Development Stages

5.7.4.1. Programming Language Specifications

In crafting an interactive and user-friendly interface, specific programming languages were carefully selected for both the front-end and back-end development of the proposed system (web and mobile).

- **Front-end Design:** The front-end design of the ASRMS focuses on creating an intuitive and user-friendly interface to enhance the overall user experience. This phase involves meticulous attention to shaping the layout, navigation menus, and interactive elements, ensuring a seamless interaction between users and the application's back-end. The chosen programming languages for establishing this critical link are:
 - **Web application:** As stated earlier, prototype design for this application was created on Figma, upon further development, the programs below are intended for use.
 - **Hypertext Markup Language (HTML):** HTML serves as the foundational markup language, defining the structure and content of the ASRMS interface.
 - **Cascading Style Sheet (CSS):** CSS is employed to style and format the HTML elements, ensuring a visually appealing and cohesive design.
 - **jQuery:** jQuery is utilised to enhance the interactivity of the ASRMS interface.
 - **Mobile Application**
 - **Flutter Framework:** Chosen for its cross-platform capabilities, providing a unified codebase for multiple platforms, and featuring built-in security measures.
 - **Dart Programming Language:** Ensured seamless integration and performance efficiency, contributing to the overall effectiveness of the front-end development.

- **User Interface Design:** Figma was selected for mobile app UI design due to its collaborative features, real-time editing, and cross-platform accessibility for development.

This front-end design approach aligns with best practices, prioritising a user-centric experience while emphasising simplicity and compatibility. The chosen programming languages and libraries provide a responsive and visually appealing ASRMS interface, facilitating effective communication between users and the underlying system.

- **Back-end Development:** The back-end development of the Automated Student Result Management System (ASRMS) encompasses the creation of the server-side architecture, database structure, and APIs. It involves strategic technology and framework selection to support the app's functionality, scalability, and security. Key elements to be included during the development of the web application prototype are stated below:
 - **Business Logic Implementation:** Python implements business logic seamlessly, focusing on the Flask framework. This choice ensures the development of efficient and reliable functionality crucial for the ASRMS.
 - **Microservices Architecture:** The back-end architecture relies on a Microservices Architecture, which enables the system to be modular and scalable. This approach promotes effective event handling and communication between services. While using an event-driven framework is not mandated, the Microservices Architecture alone provides the necessary flexibility and modularity for the ASRMS.
 - **Database Management:** MySQL is selected for its robust ecosystem, specifically for designing and managing student data across multiple databases. This choice reflects a comprehensive approach that ensures the development of a robust and effective Automated Student Result Management System tailored to the specific needs of secondary school in the Nigerian educational sector.

- **Mobile Application**

- **Firebase database:** Firebase was chosen for the mobile app backend due to its ease of use, real-time database and capabilities, authentication, and comprehensive feature set such as scalability, facilitating efficient data management.

This back-end development approach guarantees prompt servicing of front-end requests, emphasising functionality, scalability, and security in alignment with the unique needs of the Nigerian educational sector.

5.7.4.2. External Service Integration

Seamless integration with external services, including geolocation APIs, payment gateways, and messaging systems, enhances ASRMS functionality.

Technology Selection: In crafting the technological framework, HTML, CSS, and jQuery takes center stage for front-end web app development, leveraging their unique strengths to craft dynamic and interactive web interfaces (Aquino & Gandee, 2023). The choice to stick with HTML, CSS, and jQuery, despite exploring alternatives like React, Angular, and Vue.js, is rooted in their simplicity, widespread adoption, compatibility, and lightweight interactivity. Python scripts are the preferred tool for back-end web app development for data handling, chosen for their clean, readable syntax that enhances productivity and minimises error likelihood (Dunkel et al., 2011). This readability expedites development and simplifies maintenance, seamlessly integrating with deployment, automation, and infrastructure management tools and services. Notably, other languages, like PHP, JavaScript, Ruby were intentionally excluded from consideration. In line with the streamlined data processing approach, MySQL is chosen as the database storage solution, capitalising on its robust ecosystem and providing efficient data administration and monitoring tools. This approach aligns with the system's objectives, focusing on simplicity and optimal integration.

For the mobile app, the technology selection aligns with a focus on efficiency and user experience. Flutter and Dart were chosen for the front-end due to Flutter's cross-platform capabilities, providing a unified codebase, and Dart's seamless integration and performance efficiency. Firebase was selected for the backend, offering real-time database features, ease of use, authentication capabilities, and scalability. This combination ensures a streamlined and effective mobile app development process, prioritising simplicity, compatibility, and optimal integration.

5.8. Deployment and Hosting Requirements for the ASRMS

Upon development of the web application, the Automated Student Result Management System (ASRMS) for Secondary School Education will be leveraging Render.com for its hosting and deployment needs on the web. Render.com, a versatile cloud platform, simplifies application deployment and management with its user-friendly interface, automated workflows, and seamless integrations (Hall, 2020). This choice stems from its streamlined deployment process and reduced administrative overhead, critical for efficient operation. With each deployment, Render proceeds through the following commands for a service:



Figure 5.22: Deploy Steps (Source: Render, 2023)

Consideration was given to major cloud platforms like Amazon Web Services, Microsoft Azure, Google Cloud Platform, and IBM Cloud. However, Render.com emerged as the preferred option due to its simplicity, less engineering and cost-effectiveness. The platform's support for direct deployment from Git repositories aligns seamlessly with the ASRMS codebase stored in version control, facilitating a smooth connection and deployment process. According to Hall (2020), it also automates the scaling, monitoring and alerting processes related to performance.

Render.com's simplified database management further enhances the system's efficiency. Its cost-effectiveness and user-friendly features position Render.com as an optimal choice for hosting and deploying the ASRMS. This decision ensures that the ASRMS benefits from a reliable and accessible cloud infrastructure, empowering developers of varying expertise levels in managing and maintaining the system effectively.

5.9. Risks, Challenges, and Mitigation

The table below outlines a structured approach to identifying potential risks and challenges that could arise during this research along with potential mitigation actions to address the issues identified:

Table 5.9: The Potential Risk, Challenges, and Mitigation for the Proposed Study

#	Potential Risks	Challenges	Mitigation Actions
1	Technical Challenges	Limited technical expertise among school staff.	Conduct training sessions for school staff on system usage and maintenance.
		Integration issues with existing school systems and databases.	Thoroughly assess existing systems and conduct compatibility tests before implementation.
		Technical glitches or system failures during critical periods.	Implement regular system maintenance and backup procedures. Develop a contingency plan for downtime.
2	Data Security and Privacy Concerns	Unauthorized access to student data.	Implement robust security measures, including encryption and access controls.
		Data breaches lead to sensitive information leaks.	Regularly update security protocols and conduct penetration testing. Educate staff on the importance of data privacy.
3	Resistance to Change	Resistance from school staff and administration to adopt new technology.	Conduct awareness campaigns highlighting the benefits of the new system. Engage key stakeholders in the decision-making process.
		Lack of enthusiasm among teachers to use the system.	Provide incentives for teachers to use the system, such as training programs, recognition, or additional support.

4	Infrastructure Limitations	<p>There is a need for adequate internet connectivity in some schools.</p> <p>We need more hardware resources in certain schools.</p>	<p>Optimize the system to function offline and sync data when connectivity is restored.</p> <p>Develop system requirements that are compatible with varying levels of hardware. Advocate for infrastructure improvement where needed.</p>
5		<p>Inadequate training leading to underutilisation of the system.</p>	<p>Develop comprehensive training materials and conduct hands-on training sessions for all users. Provide ongoing support.</p>
6	Regulatory and Compliance Issues	<p>Non-compliance with education sector regulations.</p>	<p>Conduct a thorough review of relevant regulations and ensure the system aligns with them. Seek legal counsel if necessary.</p>
		<p>Changes in educational policies affect the system.</p>	<p>Stay informed about policy changes and be ready to adapt the system accordingly.</p> <p>Establish a flexible system architecture.</p>

5.10. Application Testing and User Feedback

The central inquiry is addressed through the development and testing of the Automated Student Result Management System (ASRMS) employing the Unified Theory of Acceptance and Use of Technology (UTAUT) as a guiding framework. The study analyses the results and feedback gathered during the testing phase, focusing on UTAUT factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions.

5.10.1. Rationale and Methodology for Testing

Testing a software entails confirming its capability to execute specified functions in alignment with the requirements outlined in the research problem statement (Briand & Labiche, 2002; Isha & Sangwan, 2014). Ariss et al. (2016) asserts this process is crucial for elevating the system's acceptance level and overall quality. Sneha and Malle (2017) categorise unit test, integration test, system test,

and acceptance test as the four strategies commonly applied in software testing. It underscores the vital role of testing in ensuring ASRMS functionality, acceptance, and overall quality.

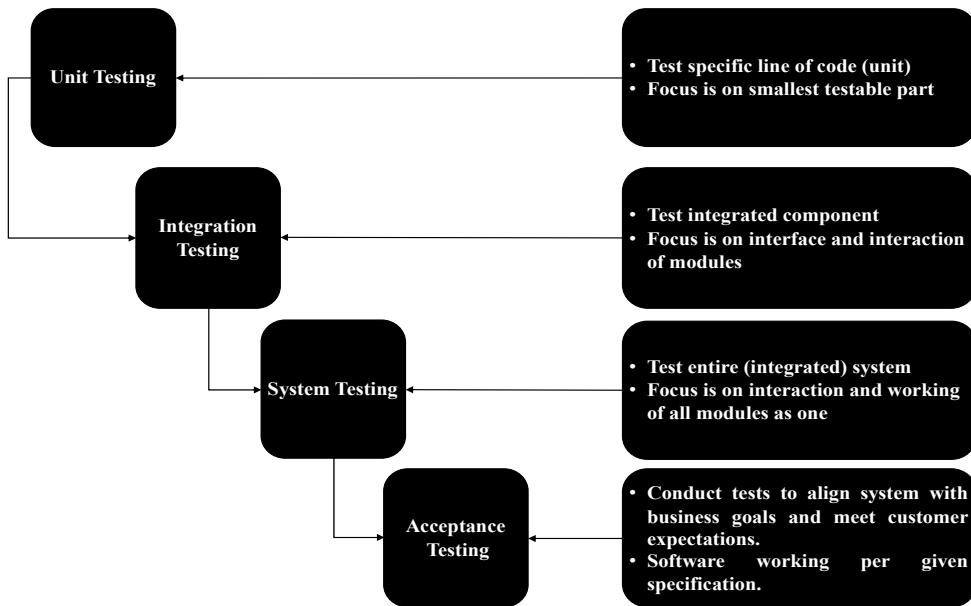


Figure 5.23: Software Testing Strategies (Source: Adapted from Isha & Sangwan, 2014)

Testing in the Automated Student Result Management System (ASRMS) encompasses unit testing, which examines individual components; integration testing, ensuring module collaboration; and system testing, evaluating overall quality in terms of performance, security, and reliability. The methodology places emphasis on user acceptance testing, aligning with the Unified Theory of Acceptance and Use of Technology (UTAUT). Anonymised as Testers 1 to 5, end-users like the Principal, Data Entry Administrator participating in semi-structured interviews were used, ensuring the ASRMS is assessed from their perspective. 3 additional testers who were professionals in the technology circle were also utilised.

Beyond interviews, the study employed beta testing in a real-world environment. Combining these phases ensures a comprehensive evaluation of the ASRMS, meeting specific requirements and aligning with diverse user expectations. The approach facilitates user validation and ensures that the ASRMS not only operates effectively on an individual and integrated level but also fulfills end-users' needs in varied operational scenarios.

5.10.2. User Acceptance Test Discussion

The findings from the user acceptance test underscore the significance of implementing an Automated Student Result Management System (ASRMS) in Nigerian secondary schools. It can be concluded that the implementation of an Automated Student Result Management System at Anchor Heights School holds significant potential to enhance the efficiency, accuracy, and overall usability of result management within the Nigerian education sector. Two prominent themes emerge from the user acceptance test (UAT) of the Automated Student Result Management System (ASRMS): User Accessibility and Efficiency and Accuracy.

In terms of User Accessibility, the UAT highlighted the system's efficacy in functionality and user experience. Users praised its accessibility, citing user-friendly interfaces and multilingual support. The evaluation considered factors such as the speed of result retrieval, real-time updates, and overall simplicity, leading to enhanced satisfaction. Technical efficiency was evident in high result processing accuracy, time savings, and improved productivity for administrators and teachers.

Furthermore, under Efficiency and Accuracy, the ASRMS demonstrated significant improvements in academic and administrative processes. Enhanced accuracy and efficiency in result processing, effective academic risk prediction, and streamlined administrative workload were notable findings. The system fosters stakeholder collaboration, promising long-term administrative advantages over traditional manual processes. Positive feedback indicates ease of use and improved academic service delivery.

Several advantages are associated with automating the student result management process in secondary schools, with a specific focus on the themes of Usability and Accessibility, Data Accuracy Assurance, Improved Efficiency, and Increased Accuracy:

- **Enhanced Usability and Accessibility:** The automated system ensures a user-friendly interface, making it easier for school administrators, teachers, and students to interact with

and access academic results. This approach particularly benefits users who may face challenges with traditional result retrieval methods.

- **Data Accuracy Assurance:** Utilizing algorithms and advanced tools, the Automated Student Result Management System ensures precise data handling and calculation of academic scores. This minimizes the risk of errors in result computation, thereby instilling confidence in the accuracy of the information presented.
- **Improved Efficiency:** Automation significantly reduces the time and effort required for result processing. This translates to quicker and more streamlined procedures for generating, reviewing, and disseminating student results. The system allows school staff to focus on more strategic tasks, promoting overall operational efficiency.
- **Increased Accuracy:** Through the application of automated algorithms, the system evaluates student performance more precisely. This enhances the reliability of academic assessments, providing a comprehensive and accurate representation of each student's capabilities and achievements.

The implementation of an Automated Student Result Management System at Anchor Heights School presents a multitude of benefits, including enhanced usability and accessibility, data accuracy assurance, improved efficiency, and increased accuracy. It is imperative for educational institutions to thoroughly consider the potential challenges and risks associated with automation, ensuring that the approach is both responsible and inclusive to cater to the diverse needs of all stakeholders involved in the education sector.

5.11. Chapter Summary

In this chapter, the study delves into the development process of the Automated Student Result Management System (ASRMS) designed for Nigerian secondary schools, guided by the Unified Theory of Acceptance and Use of Technology (UTAUT). With a primary goal of enhancing efficiency and accuracy in result processing, the chapter adopts the Rapid Application Development (RAD) methodology, emphasizing its iterative and incremental nature to meet dynamic educational

requirements. The chapter thoroughly outlines functional and non-functional ASRMS requirements, prioritizing features using the Kano Model to impact user satisfaction significantly.

Moving to the system design phase, a comprehensive use case diagram and detailed descriptions for actors (students, teachers, parents, data entry officers, and principals) are presented. Design artifacts like class diagrams, ER diagrams, and flowcharts ensure effective communication and clarity throughout development.

In summary, Chapter Five lays the groundwork for ASRMS implementation, providing a robust foundation through methodology selection, requirement delineation, prioritization, and detailed system design. The chapter's emphasis on user-centric features and a structured design approach ensures seamless alignment with the specific needs of Nigerian secondary schools, addressing varied stakeholder needs in the education sector. The subsequent comprehensive testing, with a focus on user acceptance, validates ASRMS's improved usability, precise data handling, streamlined efficiency, and enhanced accuracy, further highlighting its potential benefits for Anchor Heights School and the broader education sector in Nigeria.

Chapter Six

Discussion, Conclusion and Recommendation

6.0. Discussion

As we bring the curtain down on this comprehensive research journey, a critical reflection unfolds upon the intricate exploration undertaken to address the pivotal research question: "How does the development and implementation of an Automated Student Result Management System (ASRMS) enhance administrative efficiency, academic experiences, and contribute to overall educational progress within Nigerian secondary schools?" The preceding chapters meticulously navigated through existing administrative processes, the development of the automated system, and the assessment of its impact. This conclusion acts as the nexus between the groundwork laid in previous sections and the illuminating insights that beckon ahead, stemming from a qualitative evaluation that delved into the transformative potential of the Automated Student Result Management System in revolutionising result management and shaping the academic trajectory of secondary school students in the Nigerian educational landscape.

6.1. Summary of Research Objectives and Methodology

The research journey was guided by specific objectives, all contributing to the overarching goal of enhancing the educational landscape in Nigerian secondary schools through the implementation of an Automated Student Result Management System. The main objective was to assess the effectiveness of ASRMS in improving result management efficiency and enhancing student academic performance. To ensure that the main objective is achievable, the research objectives highlighted below must be addressed:

- **Objective 1:** To critically examine the existing administrative processes within Nigerian secondary schools and identify areas where automation can streamline and optimize these processes. This objective comprised two critical actions to ensure its effective delivery:

- Conduct primary research with secondary school administrators to understand their impression of the current result management process.
- Review relevant literature to understand current research on ASRMS.

Based on the actions identified, the initial objective was achieved through an in-depth examination of the prevailing administrative processes within case study secondary school, a prevailing condition evident in more than 50% of Nigerian secondary schools. Interviews, surveys, and document analysis were employed to identify pain points and areas ripe for optimisation through automation. This process laid the foundation for a targeted and context-specific development approach.

- **Objective 2:** To develop an automated student result management system that conforms with the specific needs and requirements of educational institutions in the Nigerian context, enhancing the academic experiences of students and educators. This objective comprised a critical action to ensure its effective delivery which is to develop an ASRMS software as a proof of concept.

The development phase involved translating the identified needs and requirements into a functional and user-friendly Automated Student Result Management System. The system was designed with a keen understanding of the Nigerian secondary school educational context, incorporating features that cater to the unique demands of students, parents, educators, and administrative staff. The development of a mobile application, along with the simultaneous creation of a web-based prototype, reflects a user-centric approach. This simultaneous development strategy recognises and accommodates the varied preferences and requirements of users, providing them with the flexibility to opt for either a mobile or web platform based on their convenience and device compatibility when engaging with the application.

- **Objective 3:** To evaluate the impact of the implemented automated student result management system on administrative efficiency, academic experiences, and overall

educational progress within secondary schools in the Nigerian educational landscape through empirical research and data analysis. This objective comprised two critical actions to ensure its effective delivery:

- Analyse the data obtained and explain the findings.
- Determine the applicability of the deliverable to the education sector and test them with stakeholders to obtain feedback on the suitability and potential of additional research.

The final objective was to empirically assess the impact of the implemented Automated Student Result Management System (ASRMS). Through data collection, surveys, and analysis, the research aimed to measure improvements in administrative efficiency, enhanced academic experiences, and overall progress within the educational ecosystem. The findings from this evaluation, combined with data analysis revealing patterns and correlations in ASRMS implementation, provide valuable insights. Stakeholder testing determines the system's applicability, collecting feedback for refinement and potential research areas, fostering an adaptive tech approach in education and potentially influencing wider adoption and policies.

6.2. Summary of the Main Findings

The research targeted the Principal and the Data Entry Officer of the case study school (Anchor Heights School) both of who met the required criteria listed in Section 3.2.5.1. Zoom Meeting was used to hold the interviews. The participants were knowledgeable about their current result management process. Before the interview commenced, the researcher informed the participants of the study's purpose and the importance of sharing their experiences in response to the open-ended interview questions.

The research used the opinions and experiences of the participants to investigate a growing trend in the education sector. Each participant's answer showed how they saw the current result management

process from a different point of view. They all talked about how implementing the ASRMS can help secondary schools improve the efficiency of result management and enhance student academic performance. The study identified four themes: (a) Efficiency and Accuracy (b) User Accessibility, (c) Enhanced Educational Processes, and (d) Data Security and Privacy.

6.2.1. Discussion of the Main Findings

6.2.1.1. Efficiency and Accuracy

The research findings seamlessly align with existing literature on result automation in educational institutions, highlighting the transformative potential of Automated Student Result Management Systems (ASRMS) in streamlining processes and reducing turnaround time for result processing. By eliminating manual tasks and automating data entry, ASRMS significantly enhances both accuracy and efficiency in result management.

ASRMS plays a pivotal role in transforming the efficiency and accuracy of result processing in secondary schools. The use of iterative and rapid application development methodologies enables administrators to seamlessly review and process student results with enhanced speed and precision. Furthermore, the positive feedback loop created by efficient result processing contributes to the overall strategic enhancement of academic activities. The efficiency and accuracy of the Automated Student Result Management System (ASRMS) recognises the nuanced universal applicability of automation based on administrators' digital readiness, emphasizing the importance of providing alternative result processing options to ensure inclusivity and equal access.

ASRMS goes beyond result processing, playing a crucial role in enhancing data management practices within secondary schools. Automated data entry ensures heightened accuracy and consistency, reducing the risk of errors and elevating the overall quality of academic data. The system's robust data analysis capabilities empower administrators to derive meaningful insights swiftly and accurately. Moreover, ASRMS addresses record-keeping challenges by providing a

centralized and secure location for academic data, thereby reducing the risk of data loss and enhancing accessibility for administrators.

In summary, ASRMS emerges as a comprehensive solution contributing to the efficiency and accuracy of academic operations by automating result processing, reducing time constraints, and elevating data management practices. The detailed exploration of subthemes adds granularity, covering various dimensions and aspects of ASRMS's multifaceted role in result processing and data management.

6.2.1.2. User Accessibility

In the realm of Automated Student Result Management System (ASRMS), prioritising user accessibility while acknowledging potential disparities in digital literacy and technology access among administrators is of paramount importance. ASRMS stands out as a pivotal theme, emphasising swift access to student results for administrators. The system's design prioritises user-friendliness, ensuring efficient navigation and utilisation of result management functionalities, addressing the diverse levels of digital readiness among administrators.

ASRMS's commitment to democratise access is a central tenet, striving to ensure equal accessibility for administrators, irrespective of their digital proficiency. This inclusivity extends to advocating for alternative result processing options, acknowledging and addressing challenges associated with diverse digital readiness levels. Practical measures, such as a user-friendly interface, enable administrators to effortlessly navigate the system, promoting efficient interactions and making ASRMS accessible to individuals with varying technological expertise.

Moreover, the system's emphasis on ease of use is exemplified through its provision of alternative result processing options, allowing administrators with varying digital readiness levels to engage effectively. Through a user-centric design and advocacy for alternatives, ASRMS aims to democratise access to technological solutions, making the benefits of automation accessible to all stakeholders involved in result processing.

In the realm of advanced data management practices within ASRMS, user accessibility continues to take center stage. The integration of automation features serves a pivotal role in providing real-time access to academic records, ensuring a seamless and timely retrieval of information. This emphasis on user accessibility extends beyond administrators to encompass students, parents, and guardians, fostering a collaborative environment for student support.

The introduction of automation features in ASRMS significantly enhances the user experience, prioritising real-time access to academic records. This inclusivity extends access to students, parents, and guardians, fostering collaboration among different stakeholders in supporting students. In conclusion, user accessibility is intricately woven into ASRMS's design, offering an effortless navigation experience for administrators, students, and parents. The commitment to inclusivity within the system goes beyond mere accessibility, emphasising collaboration and actively involving different stakeholders in student support. ASRMS, with its structured approach to user accessibility, plays a pivotal role in democratising access to academic information and ensuring that the benefits of automation are accessible to all stakeholders involved in result processing.

6.2.1.3. Enhanced Educational Processes

The positive impact of the Automated Student Result Management System (ASRMS) on educational processes is well-supported by literature emphasising automation's role in providing timely feedback, personalised learning experiences, and improved parental engagement (Dalberg, 2021). These components collectively contribute to a holistic approach to academic support and student success. Within the theme of "Enhanced Educational Processes" in ASRMS, two subthemes, "Enhanced Student Academic Performance" and "Parental Engagement," further illuminate specific dimensions through which the system positively impacts educational processes.

A cornerstone finding of the research is the potential of ASRMS to enhance student academic performance, introducing features that empower administrators for efficient progress tracking. Timely feedback becomes a central component, enabling administrators to provide students with

prompt insights into their academic journey. Key components include efficient progress tracking, timely feedback as a catalyst for improvement, and personalised learning approaches that go beyond traditional academic support. Automation allows administrators to tailor learning experiences for individual students, providing targeted support and resources. This personalised learning paradigm aligns with contemporary educational philosophies that recognise diverse student learning needs.

Parental engagement is another pivotal facet of enhanced educational processes facilitated by ASRMS. The system ensures real-time access for parents to monitor their child's academic progress, fostering a collaborative environment where parents can actively support their child's learning journey. This real-time engagement enhances the overall educational experience for students, as parents become integral participants in their academic journey.

In summary, ASRMS emerges as a transformative tool within enhanced educational processes, contributing to a holistic approach to student academic performance. By facilitating timely feedback, introducing personalised learning approaches, and fostering parental engagement, the system aligns with the evolving landscape of contemporary education, promoting a collaborative and supportive learning environment.

6.2.1.4. Data Security and Privacy

The research emphasizes the pivotal role of Automated Student Result Management System (ASRMS) in enhancing data security and privacy, aligning with literature advocating for secure and centralized data management systems in educational institutions. While automation in result processing brings numerous benefits, responsible use and consideration of privacy concerns are critical aspects requiring attention in ASRMS implementation.

The research acknowledges the importance of data security and privacy in the context of result processing, emphasizing the need for administrators to possess digital skills or have access to technology for online result processing. The automation of result processing necessitates a robust digital infrastructure, ensuring that the implementation of ASRMS aligns with data security best

practices. This careful consideration aims to guarantee that the benefits of automation are harnessed without compromising the integrity of sensitive academic data.

The focus on data security extends to improved data management practices introduced by ASRMS. Addressing concerns related to data errors or loss, the system provides a centralized and secure location for academic data. Automated record-keeping features ensure that academic records are stored and managed efficiently, significantly reducing vulnerabilities related to data security and privacy. This proactive approach aligns with contemporary standards for responsible data management in educational settings.

In conclusion, ASRMS demonstrates a robust commitment to data security and privacy by incorporating features that safeguard academic data. The system's focus on a secure and privacy-conscious framework ensures that the benefits of automation are realized responsibly within the educational context. This structured approach to dissecting the main theme into subthemes provides a comprehensive understanding of how ASRMS positively impacts educational processes, addressing critical aspects such as student performance, parental engagement, and data security and privacy.

The strategic integration of ASRMS not only enhances administrative efficiency and educational processes but also exemplifies a responsible approach to data management, reflecting the system's commitment to fostering a secure and privacy-conscious learning environment.

6.3. Conclusion

As demonstrated throughout this research, implementing the Automated Student Result Management System (ASRMS) can assist secondary schools in improving the efficiency of result management and enhancing student academic performance. Automating the result management process can make result processing more efficient and reduce the time spent managing academic data. ASRMS can lead to improved academic experiences and satisfaction of students. The ASRMS can also improve data management, enhance student academic performance, and make record keeping easier for administrators. Therefore, if secondary schools are interested in improving the efficiency of result

management and enhancing student academic performance, implementing the ASRMS would be the best strategic step for achieving higher productivity levels.

6.3.1. Contribution to the Nigerian Education Policies

The research endeavor into the implementation of Automated Student Result Management Systems (ASRMS) in Nigerian secondary schools stands as a pivotal contribution to the ongoing enhancement and formulation of education policies within the country (Udeze et al., 2017). This comprehensive study yields far-reaching implications for policymakers, administrators, and educators who aspire to harness the transformative power of technology for educational advancement.

To commence the study, a thorough examination of the existing administrative processes within Nigerian secondary schools is undertaken. This analysis identifies key areas where automation, particularly through the integration of the Automated Student Result Management System (ASRMS), can effectively streamline and optimise these processes. The subsequent evidence of improved efficiency and accuracy in result management serves as a cornerstone, shedding light on the system's potential to address longstanding administrative challenges. Moreover, the study provides valuable insights into the potential of the proposed system to streamline result processing in secondary schools (Añulika et al., 2014; Ogochukwu D, 2022). The demonstrated enhancement in efficiency and accuracy underscores the system's capability to tackle enduring administrative challenges (Johnes et al., 2017; Udeze et al., 2017). Importantly, these findings inform education policymakers about the practical benefits of integrating technology into existing educational frameworks, offering recommendations for the adoption of ASRMS to enhance result processing—a basis for potential policy adjustments and implementations.

Moreover, this research actively engages with the developmental process of an Automated Student Result Management System (ASRMS) tailored specifically to meet the unique needs and requirements of educational institutions in the Nigerian context. The focus extends beyond mere technological implementation; it emphasises enhancing the academic experiences of students and

educators alike. Simultaneously, the study sheds light on the role of ASRMS in fostering an inclusive and accessible learning environment (Suleiman et al., 2022). By highlighting user accessibility and considering the digital readiness of administrators, the research acknowledges the diverse landscape of technological proficiency among stakeholders. In going beyond generic solutions, the study offers insights into the customisation required for optimal functionality within the unique landscape of Nigerian secondary schools. Policymakers can leverage these insights to design inclusive policies that accommodate varying levels of digital literacy, ensuring that the benefits of ASRMS are accessible to all schools and administrators, regardless of their technological expertise.

Additionally, the research addresses data security in education, proposing ASRMS features for secure and privacy-conscious data management. These insights guide policymakers in formulating policies aligned with evolving data protection laws (Ojo & Akhigbe, 2020). Furthermore, the study empirically assesses ASRMS impact on administrative efficiency, academic experiences, and overall educational progress (Barrenechea et al., 2023). This data-driven understanding ensures a comprehensive evaluation of the system's implications, providing valuable insights for enhancing educational technology while prioritising privacy and efficiency within the unique context of Nigerian secondary schools (Akinyemi et al., 2022; Schildkamp, 2019).

In summary, evidence-based recommendations form a solid foundation for policymakers, offering insights into ASRMS adoption benefits, inclusivity promotion, and data security concerns. A valuable resource for navigating educational technology, the study guides efforts to enhance efficiency, accessibility, and security in Nigerian secondary schools.

6.3.2. Contribution to Theory

The research into the building of an Automated Student Result Management System (ASRMS) in secondary schools significantly contributes to the prevailing body of knowledge on integrating technology in the education sector, contributing to theoretical frameworks in educational technology. A primary contribution of the research lies in the employment of the Unified Theory of Acceptance

and Use of Technology (UTAUT) to investigate the implementation of Automated Student Result Management Systems (ASRMS) in secondary schools. Venkatesh et al. (2003) assert that the Unified Theory of Acceptance and Use of Technology (UTAUT) is widely acknowledged and firmly established as a theoretical framework aimed at comprehending the diverse factors influencing the adoption of technology.

In the context of this research, the application of UTAUT allows researchers to systematically analyse how critical factors like performance expectancy, effort expectancy, social influence, and facilitating conditions impact the acceptance and utilisation of the system by administrators, teachers, and other stakeholders (Abbad, 2021; Ajzen, 2011; Taylor & Todd, 1995; Venkatesh et al., 2003). For instance, performance expectancy assesses the perceived benefits and improvements that ASRMS brings to result processing and academic operations. Effort expectancy evaluates the perceived ease of use and user-friendliness of the system, crucial for its successful implementation.

Another contribution of the research is its empirical evidence on the impact of ASRMS on the efficiency of result management and student academic performance. The research found that ASRMS can potentially bring significant improvement to the speed and accuracy of result processing, leading to improved academic experiences and satisfaction of students (Rajpurohit et al., 2022). This finding has important implications for the use of technology in the education sector, as it suggests that automation can play a crucial role in improving the performance of secondary schools and supporting academic excellence.

The research extends academic literature by delving into the intersection of academic excellence and the role of technology in supporting economic development (Roztocki et al., 2019). By investigating the impact of Automated Student Result Management Systems (ASRMS) on educational processes, the study not only enriches the discourse on academic excellence but also addresses the broader implications for economic growth. This contribution underscores the interconnectedness of

educational advancements and their potential to drive socioeconomic progress, aligning with contemporary discussions on leveraging technology for holistic development.

Overall, the research on ASRMS in secondary schools in Nigeria has contributed to the literature on technology adoption in the education sector and the role of technology in supporting economic development. The application of UTAUT and the empirical evidence provided by the research have added to the deeper comprehension of the factors that influence the adoption of ASRMS and the impact of this technology on the performance of secondary schools.

6.3.3. Contribution to Practice

The contribution of research to practice signifies its influence on real-world situations and decision-making processes (Marabelli & Vaast, 2020). In the context of building an Automated Student Result Management System (ASRMS) for secondary schools, research plays a pivotal role in shaping more effective and efficient systems for educational management. This can lead to enhanced educational inclusivity and contribute to academic growth, fostering a more equitable and accessible learning environment.

Research contributes to the practice of ASRMS by identifying best practices and strategies for successful implementation. For instance, the study may highlight the significance of providing comprehensive training and support to administrators, ensuring they can navigate and utilise the system seamlessly (Kim et al., 2019; Venkatesh et al., 2003). Addressing potential technical issues and errors is also emphasised, guaranteeing the successful adoption of the ASRMS with positive outcomes from institutions.

Moreover, research in this field can shed light on the factors influencing the adoption and use of the ASRMS. By delving into user attitudes and perceptions, the study may uncover valuable insights that enable educational institutions to tailor the system to the specific needs and preferences of administrators (Idroes et al., 2023). According to Rapp & Corral-Granados (2021), this user-centric

approach ensures a more inclusive and user-friendly system to help galvanise management of educational institutions positively.

In addition, research contributes to the practice of ASRMS by examining its impact on key performance indicators, such as result processing time, accuracy, and overall efficiency (Liu, 2023; Rainy et al., 2023). By assessing these metrics, educational institutions can gauge the effectiveness of the ASRMS and identify areas for continuous improvement, fostering a culture of ongoing enhancement.

Overall, research significantly enhances the practice of implementing an ASRMS in secondary schools. Through the identification of best practices, exploration of adoption influencers, and evaluation of key performance indicators, research provides a foundation for the development and implementation of a robust and efficient system for academic result management.

6.3.4. Limitations of the Research

The limited spatial and temporal scopes of this research are the primary areas responsible for the study's limitations. Firstly, the research only focuses on building an Automated Student Result Management System (ASRMS) for a single secondary school in Ogun state and its peculiarities. Expanding the scope of the research would undoubtedly result in improved resources, but such an extension would require significant time and resources.

Additionally, the research has only been conducted over two months, during which the researcher was only able to develop, test, and evaluate the Automated Student Result Management System (ASRMS) on Mobile application (Android version) for its usability and relevancy based on the responses received. The web version was only created as a design prototype unable to get to its development stage. Although this timeframe is manageable, it is relatively unrealistic for a meaningful evaluation of the influence of an ASRMS and for a well-developed web application system in the Nigerian education sector. Conducting genuine research into the usefulness, repercussions, development and deployment of such a system (web and mobile) would require a

minimum of six months. Within this time frame, the researcher would be able to evaluate the extent to which the school administration, teachers, parents, and students were satisfied with the system and its effect on the amount of work done and the efficiency level.

6.3.5. Future Research

There are several areas where further research on ASRMS in the Nigerian education sector may be helpful:

- **Impact on student performance:** It would be helpful to conduct further research to understand the impact of ASRMS on student performance, particularly in secondary schools. This research could include studying how automation improves student performance and the impact on their access to feedback and other academic support services.
- **User behaviour:** More research is needed to understand how teachers, parents, and students interact with ASRMS and the factors influencing their adoption and use of these systems. Further research could include studying the motivations and behaviours of teachers using ASRMS and the factors influencing their satisfaction with these systems.
- **Regulatory implications:** Further research could be helpful to understand the regulatory impact of ASRMS in the Nigerian education sector and to identify best practices for regulating this technology. This implication could include studying the effects of automation on student privacy and fair assessment practices, along with an exploration of potential risks and challenges associated with its implementation.
- **Comparative studies:** Conducting comparative studies that investigate the experiences of secondary schools in diverse regions with varying regulatory frameworks and market conditions could contribute to a valuable insight into the factors influencing the adoption and impact of Automated Student Result Management Systems (ASRMS).

Overall, there are many areas where further research on ASRMS in the Nigerian education sector could be helpful in better understanding the impacts and implications of this technology and informing policy and practice.

6.3.6. Future Scope in Student Result Management

In charting the future course of this research, a strategic focus on cutting-edge technologies like artificial intelligence (AI), machine learning (ML), and predictive analytics aims to elevate Automated Student Result Management Systems (ASRMS) in educational technology (Kuleto et al., 2021). Through seamless AI and ML integration, we enable predictive analytics in result processing, foreseeing academic trends, identifying areas for student enhancement, and offering personalised insights (Forero-Corba & Bennasar, 2024); Gligoreea et al., 2023). This predictive prowess transforms decision-making for educators and champions a data-driven paradigm for student success.

Augmenting administrative tasks through AI algorithms is pivotal. Ezziani et al. (2022) asserted that enhancing data analysis uncovers intricate academic performance patterns. Futuristic research roadmap includes a thorough examination of ethical considerations in AI and ML application, safeguarding data privacy and addressing biases (Safdar et al., 2020).

In summary, a forward-looking agenda exploring AI, ML, and predictive analytics promises transformative result management in education (Gruetzemacher & Whittlestone, 2022). Envisioned outcomes involve a more personalized, efficient, and data-informed educational landscape, with reduced errors, heightened transparency, and expanded access—especially in underserved areas. This transformative journey requires a vigilant approach, addressing potential risks and establishing ethical safeguards in the incorporation of these technologies (Safdar et al., 2020).

6.3.7. Final Thoughts

In conclusion, the introduction of an Automated Student Result Management System (ASRMS) holds great promise for enhancing the efficiency and scope of result management in secondary schools. The automation of this process has the potential to elevate academic performance and contribute to the

overall advancement of education on a national scale. However, it is crucial for educational institutions to approach automation with careful consideration of potential risks and challenges, ensuring a responsible and inclusive implementation that benefits both the school and its students. Conducting further research on the impact and consequences of automating result management through ASRMS can inform better policies and practices, ultimately increasing the likelihood that ASRMS will foster academic growth and promote responsible education.

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Appendix A: Research Project Plan

Project Lead	Akinlunde Dammy Ogunyemi	Project Start	25/09/2023	End Date	Status
Task No.	Task Description	Duration (Days)	Start Date	End Date	
1	Project Initiation	5	25-Sep-23	29-Sep-23	Complete
1.1	Meet with Supervisor	1	25-Sep-23	25-Sep-23	Complete
1.2	Refine ideas behind research topic	2	26-Sep-23	27-Sep-23	Complete
1.3	Develop project plan and timeline	2	28-Sep-23	29-Sep-23	Complete
2	Project Planning	11	30-Sep-23	10-Oct-23	Complete
2.1	Identify project stakeholders and roles	1	30-Sep-23	30-Sep-23	Complete
2.2	Commence Ethics process	9	01-Oct-23	09-Oct-23	Complete
2.3	Obtain Ethics approval	1	10-Oct-23	10-Oct-23	Complete
4	Define Research Questions and Objectives	11	10-Oct-23	29-Oct-23	Complete
4.1	Formulate clear research questions	4	10-Oct-23	13-Oct-23	Complete
4.2	Define research objectives	5	14-Oct-23	18-Oct-23	Complete
4.3	Write the Introduction to the Research	2	19-Oct-23	20-Oct-23	Complete
3	Literature Review	9	20-Oct-23	28-Oct-23	Complete
3.1	Identify relevant literature sources	6	20-Oct-23	25-Oct-23	Complete
3.2	Review and summarize literature	3	26-Oct-23	28-Oct-23	Complete
5	Develop Research Methodology	9	29-Oct-23	06-Nov-23	Complete
5.1	Choose research philosophy and approach	2	29-Oct-23	30-Oct-23	Complete
5.2	Design research methodology	6	31-Oct-23	05-Nov-23	Complete
5.3	Submit chapter 1-3 for review	1	06-Nov-23	06-Nov-23	Complete
6	Data Collection	12	07-Nov-23	18-Nov-23	Complete
6.1	Conduct pilot study	6	07-Nov-23	12-Nov-23	Complete
6.2	Semi-structured interviews with stakeholders	6	13-Nov-23	18-Nov-23	Complete
7	Data Analysis	14	19-Nov-23	02-Dec-23	Complete
7.1	Thematic analysis of interview data	7	19-Nov-23	25-Nov-23	Complete
7.2	Synthesize findings and identify themes	7	26-Nov-23	02-Dec-23	Complete
8	Develop Application Prototype	26	03-Dec-23	28-Dec-23	Complete
8.1	Identification of application main features	1	03-Dec-23	03-Dec-23	Complete
8.2	Design functional and non-functional features	3	04-Dec-23	06-Dec-23	Complete
8.3	Build application	10	07-Dec-23	16-Dec-23	Complete
8.4	Evaluate application	1	17-Dec-23	17-Dec-23	Complete
8.5	User Acceptance Test	6	18-Dec-23	23-Dec-23	Complete
8.6	Meeting with Supervisor	1	24-Dec-23	24-Dec-23	Complete
8.7	Review study findings	2	25-Dec-23	26-Dec-23	Complete
8.8	Write discussion session	2	27-Dec-23	28-Dec-23	Complete
9	Project Completion	7	29-Dec-23	04-Jan-24	Complete
9.1	Write research discussion and recommendation section	3	29-Dec-23	31-Dec-23	Complete
9.2	Submit first draft	1	01-Jan-24	01-Jan-24	Complete
9.3	Make changes based on supervisor's feedback	2	02-Jan-24	03-Jan-24	Complete
9.4	Submit final draft to supervisor for review	1	04-Jan-24	04-Jan-24	Complete

Appendix B: Completed Research Ethics Form

UREC2 RESEARCH ETHICS PROFORMA FOR STUDENTS UNDERTAKING LOW RISK PROJECTS WITH HUMAN PARTICIPANTS

This form is designed to help students and their supervisors to complete an ethical scrutiny of proposed research. The University Research Ethics Policy (www.shu.ac.uk/research/excellence/ethics-and-integrity/policies) should be consulted before completing this form. The initial questions are there to check that completion of the UREC 2 is appropriate for this study. The final responsibility for ensuring that ethical research practices are followed rests with the supervisor for student research.

Note that students and staff are responsible for making suitable arrangements to ensure compliance with the General Data Protection Act (GDPR). This involves informing participants about the legal basis for the research, including a link to the University research data privacy statement and providing details of who to complain to if participants have issues about how their data was handled or how they were treated (full details in module handbooks). In addition, the act requires data to be kept securely and the identity of participants to be anonymised. They are also responsible for following SHU guidelines about data encryption and research data management. Guidance can be found on the SHU Ethics Website www.shu.ac.uk/research/excellence/ethics-and-integrity

Please note that it is mandatory for all students to only store data on their allotted networked F drive space and not on individual hard drives or memory sticks etc.

The present form also enables the University and College to keep a record confirming that research conducted has been subjected to ethical scrutiny.

The form must be completed by the student and the supervisor and independently reviewed by a second reviewer or module leader (additional guidance can be obtained from your College Research Ethics Chair¹). In all cases, it should be counter-signed and kept as a record showing that ethical scrutiny has occurred. Some courses may require additional scrutiny. Students should retain a copy for inclusion in their research project, and a copy should be uploaded to the relevant module Blackboard site.

Please note that it may be necessary to conduct a health and safety risk assessment for the proposed research. Further information can be obtained from the University's Health and Safety Website <https://sheffieldhallam.sharepoint.com/sites/3069/SitePages/Risk-Assessment.aspx>

SECTION A

1. Checklist questions to ensure that this is the correct form:

Health Related Research within the NHS, or His Majesty's Prison and Probation Service (HMPPS), or with participants unable to provide informed consent check list.

Question	Yes/No
Does the research involve?	
• Patients recruited because of their past or present use of the NHS	No
• Relatives/carers of patients recruited because of their past or present use of the NHS	No
• Access to NHS staff, premises, or resources	No

¹ College of Social Sciences and Arts - Dr. Antonia Ypsilanti (a.ypsilanti@shu.ac.uk)
College of Business, Technology and Engineering - Dr. Tony Lynn (t.lynn@shu.ac.uk)
College of Health, Wellbeing and Life Sciences - Dr. Nikki Jordan-Mahy (n.jordan-mahy@shu.ac.uk)

Question	Yes/No
• Access to data, organs, or other bodily material of past or present NHS patients	No
• Foetal material and IVF involving NHS patients	No
• The recently dead in NHS premises	No
• Prisoners or others within the criminal justice system recruited for health-related research	No
• Police, court officials, prisoners, or others within the criminal justice system	No
• Participants who are unable to provide informed consent due to their incapacity even if the project is not health related	No
• Is this an NHS research project, service evaluation or audit? <i>For NHS definitions please see the following website</i> http://www.hra.nhs.uk/documents/2013/09/defining-research.pdf	No

If you have answered **YES** to any of the above questions, then you **MUST consult with your supervisor** to obtain research ethics from the appropriate institution outside the university. This could be from the NHS or Her Majesty's Prison and Probation Service (HMPPS) under their independent Research Governance schemes. Further information is provided below. <https://www.myresearchproject.org.uk/>

2. Checks for Research with Human Participants

Question	Yes/No
1. Will any of the participants be vulnerable? <i>Note: Vulnerable people include children and young people, people with learning disabilities, people who may be limited by age or sickness, pregnancy, people researched because of a condition they have, etc. See full definition on ethics website in the document Code of Practice for Researchers Working with Vulnerable Populations (under the Supplementary University Policies and Good Research Practice Guidance)</i>	No
2. Are drugs, placebos, or other substances (e.g., food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive, or potentially harmful procedures of any kind?	No
3. Will tissue samples (including blood) be obtained from participants?	No
4. Is pain or more than mild discomfort likely to result from the study?	No
5. Will the study involve prolonged or repetitive testing?	No
6. Is there any reasonable and foreseeable risk of physical or emotional harm to any of the participants? <i>Note: Harm may be caused by distressing or intrusive interview questions, uncomfortable procedures involving the participant, invasion of privacy, topics relating to highly personal information, topics relating to illegal activity, or topics that are anxiety provoking, etc.</i>	No
7. Will anyone be taking part without giving their informed consent?	No

Question	Yes/No
8. Is the research covert? <i>Note: 'Covert research' refers to research that is conducted without the knowledge of participants.</i>	No
9. Will the research output allow identification of any individual who has not given their express consent to be identified?	No

If you have answered **YES** to any of these questions you are **REQUIRED** to complete and submit a UREC3 or UREC4 form. Your supervisor will advise. If you have answered **NO** to all these questions, then proceed with this form (UREC2).

3. General Project Details

Details	
Name of student	Akintunde Dammy Ogunyemi
SHU email address	C2044937@hallam.shu.ac.uk
Department/College	Computing
Name of supervisor	Mr. Sanjeeb Mohanty
Supervisor's email address	sanjeeb.mohanty@shu.ac.uk
Title of proposed research	Building an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector. A case study of Anchor Heights School, Ogun State, Nigeria.
Proposed start date	September 25 th , 2023
Proposed end date	December 29 th , 2023
Background to the study and the rationale (reasons) for undertaking the research (500 words)	<p>Background to the Study</p> <p>Amid the dynamic landscape of education, technology catalyzes innovation, efficiency, and efficiency advancement. Nevertheless, the Nigerian education sector grapples with the laborious management of student results, plagued by errors. This manual process depletes resources, introduces inaccuracies, and impedes timely access to vital information for students, parents, and educators. It also hinders adaptability, notably during crises like the COVID-19 pandemic.</p> <p>In response to these challenges, this essay focuses on crafting a Student Result Management System tailored to the unique requirements of the Nigerian education system. This initiative holds significance not only in streamlining administrative functions but also in fostering transparency, precision, and accessibility in evaluating and reporting student performance. By exploring the potential of this</p>

Details	
	<p>technology-driven innovation, we aim to illuminate its role in creating a more efficient, transparent, and responsive education system in Nigeria.</p> <p>Research Rationale</p> <p>The rationale for this research is rooted in the urgent need to modernize the result management system within Anchor Heights School and extend its benefits across the Nigerian education sector. It will propose the design and implementation of a customized Student Result Management System (SRMS) that aligns with the specific requirements of Nigerian secondary schools.</p> <p>In today's ever-evolving educational landscape, technology integration is imperative to maintain global education standards. As the world becomes increasingly digital, educational institutions must adapt to ensure that students are adequately prepared for the future. Implementing an SRMS offers the dual advantage of streamlining result management while imparting valuable digital skills to students and school administrators.</p> <p>The current paper-based result management system is not only time-consuming but also susceptible to errors and inconsistencies. The proposed SRMS aims to address these issues by enhancing the efficiency of result compilation, processing, and dissemination. It will minimize the likelihood of errors in result calculations and reporting, consequently increasing the overall accuracy and reliability of the system.</p> <p>Ensuring the security of students' academic records is paramount. An SRMS can securely store sensitive data, protecting it from unauthorized access, loss, or damage. Moreover, it will provide authorized stakeholders, including students, parents, and school administrators, with convenient and controlled access to academic records. This promotes transparency and accountability within the educational system.</p> <p>Implementing an SRMS offers the potential for significant cost savings over time. By reducing the dependence on physical</p>

Details	
	<p>paperwork, schools can curtail expenses related to printing, storage, and administrative overhead. This reallocation of resources enables schools to focus on critical areas of education, such as infrastructure development and teacher training.</p> <p>The selection of Anchor Heights School in Ogun State as a case study is not arbitrary; it is strategic. This esteemed institution serves as a microcosm of the challenges and opportunities that define the Nigerian secondary education system. A successful SRMS implementation here has the potential to serve as a model for other secondary schools throughout the nation, fostering a more efficient and reliable result management system.</p> <p>The Nigerian education sector faces unique challenges, notably a large student population and diverse curricula. The SRMS, therefore, will be meticulously designed to cater to these specific needs. It will accommodate various grading systems, languages, and examination boards, addressing the inherent diversity of the Nigerian educational landscape. Furthermore, it will consider challenges such as irregular internet connectivity in certain regions, ensuring that the system is accessible and functional nationwide.</p> <p>Furthermore, this research has significant policy implications as it aligns with the Nigerian government's efforts to modernize the education sector through technology. By providing a practical solution to critical issues, this research can influence the formulation and implementation of policies at both federal and state levels.</p> <p>In summary, developing a Student Result Management System for Nigerian secondary schools is a vital endeavour. This research aims to modernize result management, enhancing efficiency, accuracy, data security, and accessibility. The Anchor Heights School case study will illustrate the benefits, of contributing to national education reform.</p>
Aims & research question(s)	<p>Research Question</p> <p>How can the development and implementation of an Automated Student Result Management System enhance educational management and contribute to educational growth in Secondary Schools in the Nigerian context?</p> <p>Aim</p>

Details	
	<p>To investigate the feasibility and potential benefits of developing an Automated Student Result Management System to enhance educational management, promote transparency, and contribute to educational growth in Nigerian educational institutions, exemplified by Anchor Heights School, Ogun State.</p>
<p>Methods to be used for:</p> <ol style="list-style-type: none"> 1. Recruitment of participants 2. Data collection 3. Data analysis 	<ul style="list-style-type: none"> • Recruitment of Participants Participants will be recruited through a stratified sampling method. This process will involve selecting students, parents, teachers, and administrators from Anchor Heights School, ensuring a representative cross-section of stakeholders in the Student Result Management System (SRMS) implementation. Informed consent will be obtained from all participants. • Data Collection Data will be collected through a combination of methods, including surveys, interviews, and document analysis. Surveys will be administered to students, parents, and educators to gather quantitative data. Interviews will be conducted with key stakeholders to gain qualitative insights. Document analysis will involve reviewing existing school records and SRMS-related documents. • Data Analysis Data analysis will encompass both quantitative and qualitative techniques. Quantitative data from surveys will be analysed using statistical tools, such as Excel, SPSS, etc., to identify trends and patterns. Qualitative data from interviews and document analysis will be subjected to thematic analysis, enabling the extraction of meaningful themes and narratives. The findings will be triangulated for a comprehensive understanding of the SRMS implementation.
<p>Outline the nature of the data held, and details of anonymisation, storage, and disposal procedures as required.</p>	<p>Nature of the Data The data collected in the study will include both quantitative and qualitative information. Quantitative data will encompass academic records, survey responses, and numerical results from the Student Result Management System (SRMS). Qualitative data will consist of interview transcripts, open-ended survey responses, and document analysis findings. The data will be sensitive as it may contain personal and academic information about students, parents, teachers, and administrators at Anchor Heights School.</p> <p>Anonymisation To protect the privacy and confidentiality of participants, all data will be anonymised. Personal identifiers such as names and contact information will be removed or replaced with unique codes. The anonymity of participants will be maintained during the research process and in any resulting publications or reports.</p> <p>Storage Data will be securely stored in digital format. Password-protected and encrypted storage devices will be used to safeguard the data. Access to the data will be restricted to authorized research team members.</p>

Details	
	<p>Data will be stored for a defined period and will be regularly backed up to prevent loss.</p> <p>Disposal Procedures</p> <p>After the research is complete, data will be retained for a minimum period necessary for research validation and auditing. Subsequently, any identifiable data will be securely deleted, and non-identifiable data will be archived for future reference. Data disposal will adhere to data protection regulations and ethical standards.</p> <p>Ethical Considerations</p> <p>Informed consent will be obtained from all participants before data collection. Participants will be informed about the purpose of the research, the handling of their data, and their rights to withdraw at any time. The research will adhere to ethical guidelines, ensuring the dignity, rights, and well-being of all participants.</p> <p>Transparency and Accountability</p> <p>The research process will be transparent, and the methods, findings, and any potential conflicts of interest will be openly communicated. Regular updates and reports will be shared with participants and relevant stakeholders. The research team will be accountable for the accuracy, reliability, and ethical conduct of the study, ensuring the highest standards of integrity and professionalism throughout the research process.</p>

4. Research in External Organisations

Question	Yes/No
1. Will the research involve working with/within an external organisation (e.g., school, business, charity, museum, government department, international agency, etc.)?	Yes
2. If you answered YES to question 1, do you have been granted access to conduct the research from the external organisation? <i>If YES, students please show evidence to your supervisor. You should retain this evidence safely.</i>	No
3. If you do not have permission for access is this because: <ul style="list-style-type: none"> A. you have not yet asked B. you have asked and not yet received an answer C. you have asked and been refused access 	A

Note: You will only be able to start the research when you have been granted access.

5. Research with Products and Artefacts

Question	Yes/No
<p>1. Will the research involve working with copyrighted documents, films, broadcasts, photographs, artworks, designs, products, programs, databases, networks, processes, existing datasets, or secure data?</p>	
<p>2. If you answered YES to question 1, are the materials you intend to use in the public domain? <i>Notes: 'In the public domain' does not mean the same thing as 'publicly accessible'.</i></p> <ul style="list-style-type: none"> • <i>Information which is 'in the public domain' is no longer protected by copyright (i.e., copyright has either expired or been waived) and can be used without permission.</i> • <i>Information which is 'publicly accessible' (e.g., TV broadcasts, websites, artworks, newspapers) is available for anyone to consult/view. It is still protected by copyright even if there is no copyright notice. In UK law, copyright protection is automatic and does not require a copyright statement, although it is always good practice to provide one. It is necessary to check the terms and conditions of use to find out exactly how the material may be reused etc.</i> <p><i>If you answered YES to question 1, be aware that you may need to consider other ethics codes. For example, when conducting Internet research, consult the code of the Association of Internet Researchers; for educational research, consult the Code of Ethics of the British Educational Research Association.</i></p>	
<p>3. If you answered NO to question 2, do you have explicit permission to use these materials as data?</p> <p><i>If YES, please show evidence to your supervisor.</i></p>	
<p>4. If you answered NO to question 3, is it because:</p> <p>A. you have not yet asked permission. B. you have asked and not yet received an answer. C. you have asked and been refused access.</p> <p><i>Note You will only be able to start the research when you have been granted permission to use the specified material.</i></p>	A/B/C

SECTION B

HEALTH AND SAFETY RISK ASSESSMENT FOR THE RESEARCHER

- 1. Does this research project require a health and safety risk assessment for the procedures to be used? Discuss this with your supervisor and consult the [Risk Assessment Toolkit](#) for teaching research.**

Yes

No

(If YES the completed Health and Safety Risk Assessment form should be attached). You can find a [Blank/Sample Risk Assessment Form](#) at the Checklist, Generic and TORS Risk Assessments on the [Risk Assessment Toolkit](#)

- 2. Will the data be collected fully online (no face-to-face contact with participants)?**

- Yes (See the safety guidance for online research² and **go to question 8b**).
 No (Go to question 3)

3. Will the proposed data collection take place on campus?

- Yes (Please answer questions 5 to 8)
 No (Please complete all questions and consult with your supervisor))

4. Where will the data collection take place?

(Tick as many as apply if data collection will take place in multiple venues)

Location	Please specify
<input type="checkbox"/> Researcher's Residence	
<input type="checkbox"/> Participant's Residence	
<input checked="" type="checkbox"/> Education Establishment	
<input type="checkbox"/> Other e.g., business/voluntary organisation, public venue	
<input checked="" type="checkbox"/> Outside UK	

5. How will you travel to and from the data collection venue?

- On foot By car Public Transport
 Other (Please specify) **Online**

Please outline how you will ensure your personal safety when travelling to and from the data collection venue.

6. How will you ensure your own personal safety whilst at the research venue?

7. Are there any potential risks to your health and wellbeing associated with either (a) the venue where the research will take place and/or (b) the research topic itself?

- None that I am aware of
 Yes (Please outline below including steps taken to minimise risk)

² Safety guidance for online research includes information on how to set up online surveys and/or conduct online interviews/focus groups. These guidelines can be found in BB. Please check with your supervisor/module leader.

- 8. If you are carrying out research off-campus, you must ensure that each time you go out to collect data you ensure that someone you trust knows where you are going (without breaching the confidentiality of your participants), how you are getting there (preferably including your travel route), when you expect to get back, and what to do should you not return at the specified time.**

Please outline here the procedure you propose using to do this.

Insurance Check

The University's standard insurance cover will not automatically cover research involving any of the following:

- i) Participants under 5 years old
- ii) Pregnant women
- iii) 5000 or more participants
- iv) Research being conducted in an overseas country
- v) Research involving aircraft and offshore oil rigs
- vi) Nuclear research
- vii) Any trials/medical research into Covid 19

If your proposals do involve any of the above, please contact the Insurance Manager directly (fin-insurancequeries-mb@exchange.shu.ac.uk) to discuss this element of your project.

Adherence to SHU Policy and Procedures

Ethics sign-off		
Personal statement		
I can confirm that:		
<ul style="list-style-type: none"> • I have read the Sheffield Hallam University Research Ethics Policy and Procedures • I agree to abide by its principles. 		
Student:		
Name: Akintunde <u>Dammy</u> Ogunyemi	Date: 23 rd October 2023	
Signature:		
Supervisor ethical sign-off		
I can confirm that completion of this form has not identified the need for ethical approval by the TPREC/CREC or an NHS, Social Care, or other external REC. The research will not commence until any approvals required under Sections 4 & 5 have been received and any necessary health and safety measures are in place.		
Name: Sanjeeb Mohanty	Date: 25/10/2023	
Signature: 		
Independent Reviewer ethical sign off		
Name:	Date:	
Signature:		

Please ensure that you have attached all relevant documents. Your supervisor must approve them before you start data collection:

Documents	Yes	No	N/A
Research proposal if prepared previously	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Any recruitment materials (e.g., posters, letters, emails, etc.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Participant information sheet ³	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participant consent form ⁴	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Details of measures to be used (e.g., questionnaires, etc.)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outline interview schedule / focus group schedule	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Debriefing materials	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Health and Safety Risk Assessment Form	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Appendix C:

Initial Survey Questions 1

³ It is mandatory to attach the Participant Information Sheet (PIS)

⁴ It is mandatory to attach a Participant Consent Form, unless it is embedded in an online survey, in which case your supervisor must approve it before you start data collection.

Survey for Teachers: Understanding the need for an Automated Student Result Management System

1. Section 1 of 12: **Building an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector.**
2. Section 2 of 12: **General Information**
 - a. How old are you?
 - i. **Below 18**
 - ii. **18 - 24**
 - iii. **25 - 34**
 - iv. **35 - 44**
 - v. **45 - 54**
 - vi. **55 and above**
 - b. What is your gender?
 - i. **Male**
 - ii. **Female**
 - iii. **Not described here**
 - c. How many years of teaching experience do you have?
 - i. **1 - 5 years**
 - ii. **10 years**
 - iii. **11 - 15 years**
 - iv. **16 - 20 years**
 - v. **Above 20 years**
 - d. What class do you teach?
 - i. **Junior Secondary School**
 - ii. **Senior Secondary School**
3. Section 3 of 12: Experience and Technology Proficiency
 - a. How comfortable are you with using technology for academic-related tasks?
 - i. **Very Comfortable**
 - ii. **Comfortable**
 - iii. **Neutral**
 - iv. **Uncomfortable**
 - v. **Very Uncomfortable**
4. Section 4 of 12: **Current System Assessment**
 - a. In your opinion, what are the main challenges with the current manual result management system in your school? (Select all that apply)
 - i. **Errors in result calculation**
 - ii. **Time-consuming process**
 - iii. **Difficulty in result retrieval**
 - iv. **Lack of data security**
 - v. **Inconsistencies in record-keeping**
 - vi. **Prone to manipulation or tampering**
 - vii. **Challenges in tracking student progress over time**
 - viii. **Cumbersome record maintenance**
 - ix. **Potential for lost or misplaced records**
 - x. **Other...**
5. Section 5 of 12: Awareness and Expectations

- a. Are you aware of the concept of an automated student result management system?
 - i. Yes, very familiar
 - ii. Somewhat familiar
 - iii. Not familiar
 - b. What expectations do you have for such a system? (Select all that apply)
 - i. Real-time result updates
 - ii. User-friendly interface
 - iii. Secure data storage and backup
 - iv. Accessibility from various devices
 - v. Automated report generation
 - vi. Parental access to student performance
 - vii. Integration with existing school management systems
 - viii. Comprehensive training and support for staff
 - ix. Efficient communication channels
 - x. Scalability to accommodate growth in student numbers
 - xi. Other...
6. Section 6 of 12: Integration Considerations
- a. Do you believe the new system should integrate seamlessly with other existing school management systems?
 - i. Yes, essential for efficiency
 - ii. Yes, but not essential
 - iii. No, it should operate independently
 - iv. No opinion
7. Section 7 of 12: User Interface Preferences
- a. How important is a user-friendly interface for you in an automated result management system?
 - i. Extremely important
 - ii. Important
 - iii. Neutral
 - iv. Not important
 - v. No opinion
8. Section 8 of 12: Training and Support
- a. How crucial is comprehensive training and support for school staff during the implementation phase of the new system?
 - i. Extremely crucial
 - ii. Crucial
 - iii. Neutral
 - iv. Not crucial
9. Section 9 of 12: Data Security and Confidentiality
- a. How concerned are you about the security of student data in an automated system?
 - i. Very concerned
 - ii. Concerned
 - iii. Neutral
 - iv. Not concerned
10. Section 10 of 12: Feedback Mechanism

a. Should the system include a feedback mechanism for teachers to report issues or suggest improvements?

- i. Yes, definitely
- ii. Yes, but limited
- iii. No, not necessary
- iv. No opinion

11. Section 11 of 12: Communication Channels

a. What is your preferred method of communication for system updates and notifications?

- i. Email
- ii. SMS/Text messages
- iii. Mobile app notifications
- iv. In-App Notifications
- v. Other...

12. Section 12 of 12: Overall Willingness to Adopt

a. Based on the described features, how likely are you to adopt and use the automated student result management system?

- i. Very Likely
- ii. Likely
- iii. Neutral
- iv. Very Unlikely

b. Any additional comments or suggestions regarding an ideal automated student result management system? (Open-ended)

Appendix D:

Initial Survey Questions 2

Survey for Students: Understanding the need for an Automated Student Result Management System

1. Section 1 of 12: Building an Automated Student Result Management System for Secondary Schools in the Nigerian Education Sector.

a. Section 1: Consent Statement

Before participating in this survey, please read the following statement. I hereby provide my consent to participate in this research survey. I understand that my responses will be used purely for academic research purposes, and I have the right to withdraw from the survey at any stage.

- i. Yes
- ii. No

2. Section 2 of 12: General Information

a. How old are you?

- i. Below 18
- ii. 18 - 24
- iii. 25 - 34
- iv. 35 - 44
- v. 45 - 54
- vi. 55 and above

b. What is your gender?

- i. Male
- ii. Female
- iii. Not described here

c. What class do you belong to?

- i. Junior Secondary School
- ii. Senior Secondary School

3. Section 3 of 12: Awareness and Expectations

a. How comfortable are you with using technology for academic-related tasks?

- i. Very Comfortable
- ii. Comfortable
- iii. Neutral
- iv. Uncomfortable
- v. Very Uncomfortable

b. Are you aware of the concept of an automated student result management system?

- i. Yes, very familiar
- ii. Somewhat familiar
- iii. Not familiar

c. What expectations do you have for such a system?

- i. Real-time result updates.
- ii. User-friendly interface.
- iii. Secure data storage and backup.
- iv. Accessibility from various devices.
- v. Automated report generation.
- vi. Parental access to student performance.

- vii. Integration with existing school management systems.
- viii. Comprehensive training and support for staff.
- ix. Efficient communication channels.
- x. Scalability to accommodate growth in student numbers.
- xi. Other...

4. Section 4 of 12: User Interface Preferences

- a. **How important is a user-friendly interface for you in an automated result management system?**
 - i. Extremely important
 - ii. Important
 - iii. Neutral
 - iv. Not important
 - v. No opinion

5. Section 5 of 12: Access to Information

- a. **Should students have real-time access to their academic performance data?**
 - i. Yes, always
 - ii. Yes, but with restrictions
 - iii. No, not necessary
 - iv. No opinion

6. Section 6 of 12: Parental Access

- a. **Do you think parents should have access to your academic results through the system?**
 - i. Yes, always
 - ii. Yes, but with restrictions
 - iii. No, not necessary
 - iv. No opinion

7. Section 7 of 12: Data Security and Confidentiality

- a. **How concerned are you about the security of student data in an automated system?**
 - i. Very concerned
 - ii. Concerned
 - iii. Neutral
 - iv. Not concerned

8. Section 8 of 12: Ease of Use

- a. **How important is it for the system to be easy to use without requiring extensive training?**
 - i. Very important
 - ii. Important
 - iii. Neutral
 - iv. Not important
 - v. Other...

9. Section 9 of 12: Feedback Mechanism

- a. **Should the system include a feedback mechanism for teachers to report issues or suggest improvements?**
 - i. Yes, definitely
 - ii. Yes, but limited

- iii. No, not necessary
- iv. No opinion

10. Section 10 of 12: Device Accessibility

- a. How essential is it for you to access the system from various devices (e.g., mobile phones, tablets, computers)?
 - i. Extremely essential
 - ii. Essential
 - iii. Neutral
 - iv. Not essential

11. Section 11 of 12: Communication Channels

- a. What is your preferred method of communication for system updates and notifications?
 - i. Email
 - ii. SMS/Text messages
 - iii. Mobile app notifications
 - iv. In-App Notifications
 - v. Other...

12. Section 12 of 12: Satisfaction and Willingness to Adopt

- a. Based on the described features, how likely are you to adopt and use the automated student result management system?
 - i. Very Likely
 - ii. Likely
 - iii. Neutral
 - iv. Very Unlikely
- b. Any additional comments or suggestions regarding an ideal automated student result management system? (Open-ended)

1. Section 1 of 11: Consent Statement

- a. Before participating in this survey, please read the following statement. I hereby provide my consent to participate in this research survey. I understand that my responses will be used purely for academic research purposes, and I have the right to withdraw from the survey at any stage.
 - i. Yes
 - ii. No

2. Section 2 of 11: General Information

a. How old are you?

- i. Below 18
- ii. 18 - 24
- iii. 25 - 34
- iv. 35 - 44
- v. 45 - 54
- vi. 55 and above

b. What is your gender?

- i. Male
- ii. Female
- iii. Not described here

c. What class does your ward belong to?

- i. Junior Secondary School
- ii. Senior Secondary School

3. Section 3 of 11: Awareness and Expectations

a. How comfortable are you with using technology for academic-related tasks?

- i. Very Comfortable
- ii. Comfortable
- iii. Neutral
- iv. Uncomfortable
- v. Very Uncomfortable

b. Are you aware of the concept of an automated student result management system?

- i. Yes, very familiar
- ii. Somewhat familiar
- iii. Not familiar

c. What expectations do you have for such a system?

- i. Real-time result updates.
- ii. User-friendly interface.
- iii. Secure data storage and backup.
- iv. Accessibility from various devices.
- v. Automated report generation.
- vi. Parental access to student performance.
- vii. Integration with existing school management systems.
- viii. Comprehensive training and support for staff.
- ix. Efficient communication channels.
- x. Scalability to accommodate growth in student numbers.
- xi. Other...

4. Section 4 of 11: Concerns about Accessibility

- a. **How important is it for you to have access to your child's academic results through the automated system?**
 - i. Extremely important
 - ii. Important
 - iii. Neutral
 - iv. Not important
 - v. No opinion
- b. **Do you have any concerns about accessibility to the system due to factors like internet connectivity or device availability?**
 - i. Yes, significant concerns
 - ii. Yes, minor concerns
 - iii. No concerns
 - iv. No opinion

5. Section 5 of 11: Communication with Teachers

- a. **Should the system facilitate communication between parents and teachers regarding a child's academic performance?**
 - i. Yes, regularly
 - ii. Yes, but on a need basis
 - iii. No, not necessary
 - iv. No opinion

6. Section 6 of 11: Data Security and Confidentiality

- a. **How concerned are you about the security of your child's academic data in an automated system?**
 - i. Very concerned
 - ii. Concerned
 - iii. Neutral
 - iv. Not concerned

7. Section 7 of 11: Ease of Use

- a. **How important is it for the system to be easy for parents to use without requiring extensive training?**
 - i. Very important
 - ii. Important
 - iii. Neutral
 - iv. Not important
 - v. Other...

8. Section 8 of 11: Feedback Mechanism

- a. **Should the system include a feature for parents to provide feedback or report issues?**
 - i. Yes, definitely
 - ii. Yes, but limited
 - iii. No, not necessary
 - iv. No opinion

9. Section 9 of 11: Device Accessibility

- a. **How essential is it for you to access the system from various devices (e.g., mobile phones, tablets, computers)?**
 - i. Extremely essential

- ii. Essential
- iii. Neutral
- iv. Not essential

10. Section 10 of 11: Communication Channels

- a. **What is your preferred method of communication for system updates and notifications?**
 - i. Email
 - ii. SMS/Text messages
 - iii. Mobile app notifications
 - iv. In-App Notifications
 - v. Other...

11. Section 11 of 11: Satisfaction and Willingness to Adopt

- a. **Based on the described features, how likely are you to adopt and use the automated student result management system?**
 - i. Very Likely
 - ii. Likely
 - iii. Neutral
 - iv. Very Unlikely
- b. **Any additional comments or suggestions regarding an ideal automated student result management system? (Open-ended)**

Appendix F: Participant Information

GUIDANCE ON PREPARING A PARTICIPANT INFORMATION SHEET

The following issues should be addressed where relevant. This could be, but does not have to be, in a question-answer format. Use a format that best meets the needs of your research participants, but the list below summarises the areas that need to be

addressed to ensure participants are appropriately informed. Plain easily-understood language should be used with a minimum of technical or academic terms or jargon. Pay special attention to preparing material for children or adults with limited cognitive capacity - further information on this can be obtained from <http://www.hra-decisiontools.org.uk/consent/>

List of Contents Required: They do **not** have to be presented in this order as numbered questions; rather this list provides a checklist of the material that is now required to be in a Participant Information Sheet or equivalent briefing under GDPR.

1. **Title of Project:** Building an Automated Student Result Management System for Secondary Schools in Nigeria (Case Study, Anchor Heights School, Ogun state, Nigeria)
2. **Legal basis for research for studies.** The University undertakes research as part of its function for the community under its legal status. Data protection allows us to use personal data for research with appropriate safeguards in place under the legal basis of **public tasks that are in the public interest**. A full statement of your rights can be found at
<https://www.shu.ac.uk/about-this-website/privacy-policy/privacy-notices/privacy-notice-for-research>. However, all University research is reviewed to ensure that participants are treated appropriately and their rights respected. Further information at <https://www.shu.ac.uk/research/ethics-integrity-and-practice>
3. **Opening statement:** This qualitative research aims to analyse how the building of an Automated Student Result Management System could enhance academic processes in secondary schools. You are implored to participate in this semi-structured interview.
4. **Why have you asked me to take part?** You have been asked to take part in this study because you fall under the following:
 - a. Participants had to hold positions as key stakeholders in the educational sector, with roles as the Principal and the Data Entry Officer of a secondary school.
 - b. Participants must be currently working and located in Nigeria.
 - c. Familiarity with educational regulations and trends in Nigeria is a prerequisite.
 - d. Knowledge about academic record management and educational IT trends were preferred.

5. **Do I have to take part?** It is up to you to decide if you want to take part. A copy of the information provided here is yours to keep, along with the consent form if you do decide to take part. You can still decide to withdraw at any time without giving a reason, or you can decide not to answer a particular question.
6. **What will I be required to do?** You will be required to attend a semi-structured interview to understand your perception of microfinance bank.
7. **Where will this take place?** Zoom
8. **How often will I have to take part, and for how long?** Should you choose to participate, you will be required to attend an online interview. This will take about 25 to 30 mins
9. **Are there any possible risks or disadvantages in taking part?** There are no risks involved in taking part in the interview
10. **What are the possible benefits of taking part?** You will be able to share your knowledge on how automating student result management can enhance administrative efficiency, academic experience and contribute to educational progress in Secondary Schools?
11. **When will I have the opportunity to discuss my participation?** You can contact the researcher at any time using the email address.
12. **Will anyone be able to connect me with what is recorded and reported?**
Details collected during the interview will be treated confidentially.
13. **Who will be responsible for all of the information when this study is over?**
The researcher is responsible for all the data collected.
14. **Who will have access to it?** The researcher and the dissertation marker will have access to the information.
15. **What will happen to the information when this study is over?** The raw data will be deleted at the end of the research assessment period.
16. **How will you use what you find out?** The information collected will be used to prepare research report.
17. **How long is the whole study likely to last?** The study is likely to last from October 2022 to January 2023.
18. **How can I find out about the results of the study?** You can contact the researcher via email to request for a copy of the result.

Participants need to be given the opportunity to ask any further questions or seek clarification. This information needs to be provided at the end.

Details of who to contact if you have any concerns or if adverse effects occur after the study are given below.

Researcher/ Research Team**Details:** Akintunde Ogunyemic2044937@hallam.shu.ac.uk

You should contact the Data Protection Officer if: <ul style="list-style-type: none">• you have a query about how your data is used by the University• you would like to report a data security breach (e.g. if you think your personal data has been lost or disclosed inappropriately)• you would like to complain about how the University has used your personal data <p>DPO@shu.ac.uk</p>	You should contact the Head of Research Ethics (Professor Ann Macaskill) if: <ul style="list-style-type: none">• you have concerns with how the research was undertaken or how you were treated <p>a.macaskill@shu.ac.uk</p>
<p>Postal address: Sheffield Hallam University, Howard Street, Sheffield S1 1WBT Telephone: 0114 225 5555</p>	

Appendix G:**Interview Participant Consent Form**
PARTICIPANT CONSENT FORM**TITLE OF RESEARCH STUDY: Loan Process Automation in Nigeria
Microfinance Banks: A Proof of Concept**

Please answer the following questions by ticking the response that applies

- | | YES | NO |
|--|--------------------------|--------------------------|
| 1. I have read the Information Sheet for this study and have had details of the study explained to me. | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. My questions about the study have been answered to my satisfaction and I understand that I may ask further questions at any point. | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. I understand that I am free to withdraw from the study within the time limits outlined in the Information Sheet, without giving a reason for my withdrawal or to decline to answer any particular questions in the study without any consequences to my future treatment by the researcher. | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. I agree to provide information to the researchers under the conditions of confidentiality set out in the Information Sheet. | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. I wish to participate in the study under the conditions set out in the Information Sheet. | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. I consent to the information collected for the purposes of this research study, once anonymised (so that I cannot be identified), to be used for any other research purposes. | <input type="checkbox"/> | <input type="checkbox"/> |

Participant's Signature: _____ **Date:** _____

Participant's Name (Printed): _____

Contact details:

Researcher's Name (Printed): _____

Researcher's Signature: _____

Researcher's contact details:

(Name, address, contact number of investigator)

Please keep your copy of the consent form and the information sheet together.



PARTICIPANT CONSENT FORM

TITLE OF RESEARCH STUDY: Building an Automated Student Result Management System (ASRMS) for Secondary Schools in the Nigerian Education Sector

Please answer the following questions by ticking the response that applies.

- | | YES | NO |
|--|-------------------------------------|--------------------------|
| 1. I have read the Information Sheet for this study and have had details of the study explained to me. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. My questions about the study have been answered to my satisfaction and I understand that I may ask further questions at any point. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. I understand that I am free to withdraw from the study within the time limits outlined in the Information Sheet, without giving a reason for my withdrawal or to decline to answer any particular questions in the study without any consequences to my future treatment by the researcher. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 4. I agree to provide information to the researchers under the conditions of confidentiality set out in the Information Sheet. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 5. I wish to participate in the study under the conditions set out in the Information Sheet. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 6. I consent to the information collected for the purposes of this research study, once anonymised (so that I cannot be identified), to be used for any other research purposes. | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

Participant's Signature: O. Akinlunde Date: 03/01/2024.

Participant's Name (Printed): Olaikunle Oghimbo

Contact details: Anchor Height School

Researcher's Name (Printed): Akinlunde Ogunyemi

Researcher's Signature: _____

Researcher's contact details:
(Name, address, contact number of investigator)

Please keep your copy of the consent form and the information sheet together.



City Campus,
Howard Street,
S1 1WB, Sheffield,
United Kingdom.

Approved.

Admin Please Work on this.

The Principal,
Anchor Group of Schools,
18, Olaore Street, Agbado Crossing,
Ogun State, Nigeria

Dear Sir/Ma,

TITLE OF PROJECT: BUILDING AN AUTOMATED STUDENT RESULT MANAGEMENT SYSTEM (ASRMS) FOR SECONDARY SCHOOLS IN THE NIGERIAN EDUCATION SECTOR (CASE STUDY ANCHOR GROUP OF SCHOOLS).

The University undertakes research as part of its function for the community under its legal status. Data protection allows us to use personal data for research with appropriate safeguards in place under the legal basis of public tasks that are in the public interest. A full statement of your rights can be found at: www.shu.ac.uk/about-this-website/privacy-policy/privacy-notices/privacy-notice-for-research. However, all University research is reviewed to ensure that participants are treated appropriately and their rights respected. This study was approved by the University's Research Ethics Committee. Further information at: www.shu.ac.uk/research/excellence/ethics-and-integrity.

Please will you take part in a study about the "Building an Automated Student Result Management System (ASRMS) for Secondary Schools in the Nigerian Education Sector"?

You were selected for this survey because you represent the institution where information needed for this research will be gotten from. It is up to you to decide if you want to take part. A copy of the information provided here is yours to keep, along with the consent form if you do decide to take part. You can still decide to withdraw at any time without giving a reason, or you can decide not to answer a particular question. You are required to talk about your experiences, and provide datasets that would be used for this research. The project will last for two months and you might be asked for information at any point during the process.

In order to protect your privacy, confidentiality, and information provided, strict measures would be put in place to protect your privacy, confidentiality, and the information provided so you need not to worry about it. The benefit of taking part in this survey is that you would be contributing to the improvement of a better student result management process using technology through your experience, viewpoints, preferences, concerns, and through the data that you would be releasing.

The researcher is responsible for all the information when the study is over.

The information would be destroyed at the end of the study so nobody will have access to it. It will not be transferred to a third party. The result of this research will be reported and presented to the Department of Computing, Sheffield Hallam University and the study will last about two months.

The result can also be given to you upon request.

Please feel free to ask any question for clarification.

In the context of building an Automated Student Result Management System (ASRMS) for Secondary Schools in the Nigerian Education Sector, the following information is needed for the academic sessions:

- Comprehensive data on marks and result details for the specified (2021 to 2022) academic sessions.
- Additionally, permission is sought to administer survey questionnaires to gather valuable insights from key stakeholders:
 - 15 Teachers
 - 5 Parents
 - 10 Students
- Request your consent for an open interview with you, the Principal, and the Data Entry Officer of the school. This interview aims to gather information essential for the successful development and implementation of the ASRMS. Your perspectives and input will be crucial in ensuring the system aligns with the specific needs and requirements of your educational institution.

Details of who to contact if you have any concerns or if adverse effects occur after the study are given below.

Researcher/ Research Team Details:

You should contact the Data Protection Officer if:	You should contact the Head of Research Ethics (Dr Mayur Ranchordas) if:
<ul style="list-style-type: none">• you have a query about how your data is used by the University• you would like to report a data security breach (e.g. if you think your personal data has been lost or disclosed inappropriately)• you would like to complain about how the University has used your personal data <p>DPO@shu.ac.uk</p>	<ul style="list-style-type: none">• you have concerns with how the research was undertaken or how you were treated <p>ethicssupport@shu.ac.uk</p>

Postal address: Sheffield Hallam University, Howard Street, Sheffield S1 1WBT Telephone: 0114 225 5555

Appendix H:

Interview Participant Questions

Interview Questions for Principal - PRT-ASRMS1

1. Introduction and Familiarity with School Operations
 - a. Can you provide your name, position, and the duration of your service at the school?
 - b. Assess your familiarity with the functioning of secondary schools.
2. Technological Progress in Education
 - a. What is your level of knowledge regarding technological progress in education, especially in result management?
 - b. Share your thoughts on the integration of technology in education, encompassing online platforms and digital record-keeping. What pros and cons have you noticed as an educator?
3. Impact of Technological Innovations on Workload and Automated Student Result Management System Value
 - a. Can you describe the current challenges your school faces in managing student results and how these challenges affect your workload?
 - b. How do you think an Automated Student Result Management System could address or mitigate the challenges you've mentioned?
 - c. In your opinion, would the implementation of an Automated Student Result Management System (ASRMS) simplify your tasks?
 - d. Identify the specific aspects of your work that would experience the greatest advantages from the adoption of an Automated Student Result Management System.
 - e. Can you provide an estimate of the average time your school currently spends on manual processing and management of student results?
 - f. Enlist additional advantages you anticipate from the implementation of an Automated Student Result Management System.
 - g. Share your views on the overall benefits an Automated Student Result Management System could bring to your school. Do you foresee improvements in academic performance and administrative efficiency?
4. Automated Student Result Management System Design Considerations
 - a. In your perspective, which feature holds the utmost importance in the design of an Automated Student Result Management System? Is it information processing capabilities, speed, ease of use, or another factor?
 - b. If given the opportunity to design the system, how would you prioritise the interface?
 - c. Are there specific features or functionalities you would like to see in an Automated Student Result Management System that align with the unique needs of your school and contribute to the result management process e.g. tracking?
 - d. How critical do you consider data security and confidentiality in managing student results, especially in the design of an Automated Student Result Management System?
 - e. How do you envision an Automated Student Result Management System contributing to maintaining secure and confidential student data?
 - f. In your opinion, how essential is the implementation of an Automated Student Result Management System for the overall improvement of the educational system in Nigeria?

Interview Questions for Data Entry Officer - PRT-ASRMS2

1. Current Data Entry Process
 - a. Could you please provide insights into the current method of data entry for student results at your school?
 - b. Could you walk us through the steps involved in the manual result entry process?
2. Time and Resources
 - a. Are there any specific peak periods during the academic year that require additional resources for data entry?
 - b. How does the current system handle the need for quick result turnaround times?
 - c. How much time and resources, especially during peak periods like exams, are dedicated to manual data entry?
3. Accuracy Measures
 - a. How is data accuracy ensured in manual entry, and what measures are in place for error detection and correction?
 - b. What data formats are currently used for storing and sharing student result information?
4. Challenges and Integration
 - a. What challenges or difficulties do you face in the current manual data entry system for student results?
 - b. Have there been instances of data loss, duplication, or other issues in the current process?
 - c. How do you foresee automation addressing the challenges faced in the current manual data entry process?
 - d. Can you discuss how an Automated Student Result Management System might enhance the efficiency of data entry tasks in the context of managing student results?
 - e. What specific features of an Automated Student Result Management System do you believe would contribute most to improving workflow efficiency?
5. User-Friendly Interface
 - a. How crucial is a user-friendly interface, and can you share features that would make the proposed result management system user-friendly for data entry officers?
6. Data Security and Privacy
 - a. What measures should be in place to ensure security and privacy of student data within the proposed result management system?
 - b. How is student data confidentiality maintained, and how would potential security concerns in the proposed result management system data entry be handled?
7. Training and Support
 - a. How do you envision the training process for data entry officers adopting the proposed result management system, and what ongoing support mechanisms would you suggest?
8. Enhanced Educational Processes
 - a. In what ways can the proposed result management system assist in generating reports and analyzing student performance trends, and how would you utilize these capabilities to enhance your role?
 - b. How crucial is it for you to seamlessly integrate a tool like the Automated Student Result Management System into your school's existing operations, and what potential challenges do you foresee in this integration?

Appendix I: Interview Transcript

PRT-ASRMS1

Interviewer: What is your level of knowledge regarding technological progress in education, especially concerning result management?

Interviewee: I am deeply immersed in the evolving landscape of education technology, specifically in result management. I have led initiatives, like introducing online classes for secondary schools in Lagos, Nigeria. Through this, I gained hands-on insights into the transformative power of technology in education. It is not just about progress; it's understanding the pulse of change, navigating challenges, and ensuring that innovation aligns seamlessly with the essence of effective education. My experience underscores the delicate balance between potential and hurdles in upgrading result management systems.

Interviewer: Considering your experience, what are your thoughts on the integration of technology in education, including online platforms and digital record-keeping? What pros and cons have you noticed as an educator?

Interviewee: Embracing technology in education, with online platforms and digital record-keeping, enhances accessibility but poses challenges. The pros include streamlined processes and information access. However, addressing cyber-attack needs and fostering digital literacy among both staff and students is crucial. It's a delicate balance between progress and adapting to the evolving landscape of education.

Interviewer: Can you describe the current challenges your school faces in managing student results and how these challenges affect your workload?

Interviewee: Currently, our school grapples with the manual management of student results, presenting a host of challenges. The processes are time-intensive, demanding significant hours from our staff. This manual approach also introduces the potential for errors, impacting result accuracy. The cumulative effect is a substantial burden on our staff's workload, diverting valuable time and resources away from more strategic and impactful educational initiatives. Addressing these challenges through an Automated Student Result Management System holds the promise of not just efficiency but also a transformative alleviation of the administrative strain on our dedicated team.

Interviewer: Considering these challenges, how do you think an Automated Student Result Management System could address or mitigate them?

Interviewee: Implementing an Automated Student Result Management System would address these challenges by automating result management, reducing the time spent on manual processes, and minimizing the likelihood of errors.

Interviewer: That sounds promising. In your opinion, would the implementation of an Automated Student Result Management System simplify your tasks as the Principal?

Interviewee: Absolutely. Implementing an Automated Student Result Management System would be a game-changer. It's not just about simplifying tasks; it's about transforming how we work. This system holds the potential to streamline processes, reduce manual efforts, and, most importantly, enhance the overall efficiency in managing student results. As a Principal, envisioning a smoother workflow, timely feedback, and improved collaboration among stakeholders fills me with optimism about the positive impact this system can bring to our school's administrative processes. It aligns perfectly with our commitment to embracing technology for a more effective and modern educational experience.

Interviewer: Could you identify the specific aspects of your work that would experience the greatest advantages from the adoption of an Automated Student Result Management System?

Interviewee: The greatest advantages would be seen in the speed of result processing, reduction in workload for teachers, so they can focus on more teaching and improved accuracy in result calculations.

Interviewer: To get a sense of the time investment, can you provide an estimate of the average time your school currently spends on manual processing and management of student results?

Interviewee: Currently, our school spends a considerable amount of time on manual processing of student results. On average, this could amount to 15 days annually.

Interviewer: Beyond time savings, what additional advantages do you anticipate from the implementation of an Automated Student Result Management System?

Interviewee: Beyond the invaluable time savings, the implementation of an Automated Student Result Management System holds the potential for transformative benefits. With this system, we anticipate improved communication with parents, ensuring timely result dissemination, and empowering data-driven decision-making. These aspects collectively contribute to a more dynamic and responsive educational environment, aligning with our commitment to providing the best possible experience for our students and their families. Additionally, streamlined administrative processes contribute to resource optimisation, allowing the school to allocate time and effort strategically. Altogether, these advantages not only elevate efficiency but also nurture a collaborative and progressive educational environment for both students and teacher.

Interviewer: Looking at the bigger picture, what are your views on the overall benefits an Automated Student Result Management System could bring to your school? Do you foresee improvements in academic performance and administrative efficiency?

Interviewee: The overall benefits an Automated Student Result Management System could bring to our school are immense. I foresee notable improvements in academic performance, streamlined administrative processes, and heightened overall efficiency.

Interviewer: Moving into the design considerations for an Automated Student Result Management System, in your perspective, which feature holds the utmost importance? Is it information processing capabilities, speed, ease of use, or another factor?

Interviewee: In designing the student result management system, the utmost importance lies in its information processing capabilities. While speed, ease of use, and accuracy are crucial, efficient handling of extensive student data ensures timely and accurate results. Prioritizing this aligns with our goal at Anchor Group of Schools, where implementing the system initially for our Secondary school serves as a pilot project. Subsequently, we may extend it to the primary school, ensuring a phased and thoughtful integration to meet the unique needs of both educational levels. This approach aims to enhance efficiency across all levels of our institution.

Interviewer: If given the opportunity to design the system, how would you prioritise the interface?

Interviewee: Given the chance to design the system, my priority for the interface would be to ensure user-friendliness and accessibility for all stakeholders involved in the result management process. A well-designed, intuitive interface contributes significantly to the system's effectiveness, making it easier for teachers, staff, and other users to navigate and utilise the Automated Student Result Management System efficiently. This emphasis aligns with our commitment at Anchor Group of Schools to create a positive and user-centric experience for everyone involved in the educational process.

Interviewer: Are there specific features or functionalities you would like to see in an Automated Student Result Management System that align with the unique needs of your school and contribute to the result management process, for example, tracking?

Interviewee: I envision specific features in the Automated Student Result Management System (ASRMS) that align with our school's unique needs, such as mobile compatibility, customisable reporting tools, seamless integration with existing systems, students' performance tracking and user-friendly dashboards for different users. Additionally, functionality for transcript generation and approvals, automated grade calculations, real-time communication channels between teachers, students, and parents, and a centralised database for student profiles would enhance our result management process. This comprehensive set of features ensures a tailored system that caters to the specific requirements of any secondary school, fostering a more efficient and collaborative educational environment.

Interviewer: Considering the sensitive nature of student data, how critical do you consider data security and confidentiality in managing student results, especially in the design of an Automated Student Result Management System?

Interviewee: Data security and confidentiality are paramount, especially in managing student results. A well-designed Automated Student Result Management System should incorporate robust security measures to protect sensitive student information.

Interviewer: How do you envision an Automated Student Result Management System contributing to maintaining secure and confidential student data?

Interviewee: An Automated Student Result Management System plays a crucial role in securing and safeguarding student data through advanced encryption techniques, stringent access controls, and periodic security audits. This ensures that sensitive information remains confidential, protected from unauthorised access or breaches. By prioritising robust cybersecurity measures, the system instills trust in stakeholders, fostering a secure environment for managing student data. It's not just about digital locks; it's about creating a virtual fortress where each student's information is shielded, promoting confidentiality and reinforcing the integrity of the educational process.

Interviewer: Finally, in your opinion, how essential is the implementation of an Automated Student Result Management System for the overall improvement of the educational system in Nigeria?

Interviewee: Implementing an Automated Student Result Management System is not merely beneficial; it's indispensable for the holistic enhancement of the educational system in Nigeria. This initiative aligns with the trajectory of modern educational practices, fostering efficiency and transparency. Embracing technology in result management isn't just a step forward; it's a transformative leap towards a more dynamic and effective educational landscape nationwide.

Interviewer: Your insights are invaluable, Mr. Kunle. Thank you for sharing your perspectives on the potential implementation of an Automated Student Result Management System in Anchor Group of Schools.

Interviewee: It's my pleasure. I appreciate the opportunity to discuss this initiative, and I look forward to exploring it.

PRT-ASRMS2

Interviewer: Could you please provide insights into the current method of data entry for student results at your school?

Interviewee: Certainly. Presently, at Anchor Heights School, the data entry for student results involves a manual process using spreadsheets. The method includes receiving student grades and information from subject teachers, who mark the scripts, and then inputting this data into an Excel sheet for each respective subject.

Interviewer: Could you walk us through the steps involved in the manual result entry process?

Interviewee: Certainly. The manual result entry process initiates with the reception of hard copies of exam sheets. Subsequently, we meticulously input student details and corresponding grades into the Excel sheet. Upon completing the data entry, a thorough verification follows to ensure precision and accuracy in the entries. This method, though systematic, is labor-intensive and time-consuming, demanding a careful eye for detail to maintain the accuracy of student records.

Interviewer: Are there any specific peak periods during the academic year that require additional resources for data entry?

Interviewee: Yes, the peak periods are during the end-of-term exams and final result compilation. During these times, we may allocate additional staff and extend working hours.

Interviewer: How does the current system handle the need for quick result turnaround times?

Interviewee: Quick turnaround times are a challenge, especially during peak periods. We prioritise efficiency and allocate additional resources when possible to meet tight deadlines.

Interviewer: How much time and resources, especially during peak periods like exams, are dedicated to manual data entry?

Interviewee: On average, the time required for data entry varies based on the number of students and subjects, taking approximately 3 to 5 days to complete a set of student results. During peak periods, additional resources, including personnel, are allocated to handle the heightened workload. Unfortunately, this strategy, while addressing the demand, inadvertently leads to extended processing times. The increased number of staff, while aiding in managing the workload, introduces complexities that impact the efficiency of the data entry process. This underscores the need for a more sustainable solution that ensures both scalability during peak times and maintains or enhances processing speed, making the overall result management process more resilient and adaptable to fluctuations in workload.

Interviewer: How is data accuracy ensured in manual entry, and what measures are in place for error detection and correction?

Interviewee: Accuracy is paramount, and we maintain it through a meticulous process of verification and cross-referencing. After entering the data, a comprehensive review is undertaken to identify and rectify any discrepancies or errors. This careful scrutiny is crucial in ensuring the integrity of student result records. While effective, it's essential to acknowledge that this manual review process is time-intensive and can be prone to human oversight, highlighting the potential advantages that an Automated Student Result Management System could bring in terms of both accuracy and efficiency.

Interviewer: What data formats are currently used for storing and sharing student result information?

Interviewee: Student result information primarily resides in Excel spreadsheets, and for sharing purposes, we frequently convert the files to PDF format. This approach ensures uniform formatting,

facilitating seamless distribution and accessibility of student result data while maintaining consistency in presentation and accessibility across different platforms.

Interviewer: What challenges or difficulties do you face in the current manual data entry system for student results?

Interviewee: The primary challenge stems from the potential for human error, heightening the risk of inaccuracies in the results. The manual process exacerbates this issue, especially during peak periods like exam seasons, where it becomes time-consuming and prone to delays. Common errors include transposition of grades, typos in student names, and occasional miscalculations in the Excel sheet. The limitations inherent in manual data entry highlight the urgent necessity for a streamlined and automated result management approach. Such a system is crucial not only to reduce errors but also to improve overall efficiency, directly tackling these challenges and providing a more effective solution to result management in our school.

Interviewer: Have there been instances of data loss, duplication, or other issues in the current process?

Interviewee: Fortunately, we haven't experienced data loss, but there have been instances of duplication errors that required manual correction. These instances, however, are infrequent.

Interviewer: How do you foresee automation addressing the challenges faced in the current manual data entry process?

Interviewee: Automation stands as a potent solution to eradicate manual entry errors, expediting the entire process while introducing real-time data validation. This transformative shift directly targets the challenges we currently grapple with, notably enhancing accuracy and alleviating the constraints posed by time. By eliminating the tedious manual steps, an Automated Student Result Management System ensures precision in data entry and significantly accelerates result processing. The incorporation of real-time validation adds an additional layer of assurance, further fortifying the reliability of student result information. In essence, this transition promises not just efficiency gains but a fundamental improvement in the overall quality and timeliness of result management processes.

Interviewer: Can you discuss how an Automated Student Result Management System might enhance the efficiency of data entry tasks in the context of managing student results?

Interviewee: subject to your explanation of your research, and my own understanding of your explanation, I believe the proposed system can enhance efficiency by automating repetitive tasks, such as result processing, which allows data entry officers to focus on more complex aspects. It can also facilitate faster retrieval of information, improving overall workflow.

Interviewer: What specific features of an Automated Student Result Management System do you believe would contribute most to improving workflow efficiency?

Interviewee: Features such as automated result calculations, data validation checks, and intuitive interfaces for data entry officers are pivotal elements that would markedly enhance workflow efficiency. These components not only streamline the result management process but also ensure accuracy by automating calculations and implementing thorough validation checks. The incorporation of intuitive interfaces further facilitates a seamless experience for data entry officers, reducing the complexity of tasks. Collectively, these features contribute to a more efficient and user-friendly system, aligning with the overarching goal of optimising workflow in result management processes.

Interviewer: How crucial is a user-friendly interface, and can you share features that would make the proposed result management system user-friendly for data entry officers?

Interviewee: In an educational setting, a user-friendly interface is paramount due to diverse user skill levels. The Automated Student Result Management System interface must be intuitive, ensuring effective navigation for all staff members. Essential features such as clear design, easy navigation, and validation prompts streamline the user experience, particularly for data entry officers. This design focus facilitates efficient use, enhancing overall accessibility and usability within the school's result management system.

Interviewer: What measures should be in place to ensure security and privacy of student data within the proposed result management system?

Interviewee: Robust encryption protocols, access controls, and regular security audits should be implemented to safeguard student data within the Automated Student Result Management System.

Interviewer: How is student data confidentiality maintained, and how would potential security concerns in the proposed result management system data entry be handled?

Interviewee: Addressing security concerns involves constant vigilance, regular training on data security practices, and immediate response to identified threats. The manual result entry system maintains confidentiality by restricting access to authorised personnel through password protection and controlled access permissions. However, the system's vulnerability to printed documents, potential loss, and the risk of corruption poses challenges. An incident of a security breach occurred when a printed result spreadsheet was left unattended, leading to unauthorised access and intentional leakage of students' results. This emphasises the urgent need for a more secure result management system.

Interviewer: How do you envision the training process for data entry officers adopting the proposed result management system, and what ongoing support mechanisms would you suggest?

Interviewee: The training process for data entry officers adopting the proposed result management system should be comprehensive, covering theoretical and practical aspects. It includes hands-on sessions, workshops, and ongoing support to ensure a smooth transition. Continuous training sessions, a dedicated support team, and regular updates on system improvements are crucial for ongoing support and successful adaptation. This multifaceted approach ensures that staff members are well-equipped and supported throughout the implementation and beyond, fostering efficient use of the new system.

Interviewer: In what ways can the proposed result management system assist in generating reports and analysing student performance trends, and how would you utilise these capabilities to enhance your role?

Interviewee: An Automated Student Result Management System can significantly assist data entry officers by automating the report generation process and facilitating the analysis of student performance trends. Leveraging the reporting capabilities, I would extract meaningful insights from performance data, identifying trends and areas for improvement. This information can then be used to optimise data entry processes, contributing to overall educational progress and enhancing my role as a data entry officer.

Interviewer: how crucial is it for you to seamlessly integrate a tool like the Automated Student Result Management System into yours schools existing operations, and what potential challenges do you foresee in this integration?

Interviewee: Integrating the Automated Student Result Management System seamlessly into our school's existing operations is of utmost importance. It ensures a cohesive and efficient workflow. Anticipated challenges may include potential disruptions during the transition, requiring careful planning and collaboration with IT professionals. Thorough training and support mechanisms will be essential to overcome any challenges and ensure a smooth integration process, maximising the benefits of the new system.

Appendix J:

UAT Questionnaire

#	Test Scenario	Requirement Question	Yes	No	Maybe	Comments
1	User login	Can login with valid credentials?				
2	Result Entry	Can administrators be allowed to input student results?				
3	Result Retrieval	Does the system enable quick access to student results?				
4	Data Accuracy	Does the system ensure accuracy in automated result processing				
5	User Interface	Does the system provide an intuitive and user-friendly interface				
6	Accessibility	Does the system ensure accessibility to users with different digital proficiencies?				
7	Data Security	Does the system have implemented measures to secure academic data?				
8	Performance	Can you confirm the system handles a specified number of concurrent users?				
9	System Reliability	Can the system ensure minimal downtime and reliable performance?				
10	Generation of Reports	Does the system allow automated generation of academic reports				
11	Approvals	Can approvals be generated?				
12	Final Thoughts					

Appendix K: ASRMS Mobile Application Screenshot Codes and Wireframes for ASRMS Mobile Application

Code for upload result page on the Mobile App

```
        width: double.infinity,
        titleColor: Colors.white60,
        buttonColor: buttonColors,
        onTap: (){
            Navigator.push(context, MaterialPageRoute(builder: (context) =>const SignUp()));
        },
    ), // ButtonWidget
    const SizedBox(
        height: 18,
    ), // SizedBox
    const Text("Sign in as",
        style: TextStyle(
            color: mainColor,
            fontSize: 16,
            fontWeight: FontWeight.w700)), // TextStyle, Text
    const SizedBox(
        height: 8,
    ), // SizedBox
    Row(
        mainAxisAlignment: MainAxisAlignment.spaceAround,
        children: [
            Flexible(
                child: Padding(
                    padding: const EdgeInsets.all(4.0),
                    child: ButtonWidget(
                        title: "Student",
                        fontSize: 14,
                        width: 300,
                        titleColor: Colors.white60,
                        buttonColor: buttonColors
                    )
                )
            )
        ]
    )
)
```

Code for the welcome page on the Mobile App

```
backgroundColor: Colors.white,
body: loading ? const LoadingIndicator() : GestureDetector(
  onTap: () => FocusScope.of(context).unfocus(),
  child: Form(
    key: _formKey,
    child: Container(
      decoration: const BoxDecoration(
        image: DecorationImage(
          image: AssetImage("assets/images/bg.jpg"),
          fit: BoxFit.cover,
        ), // DecorationImage
      ), // BoxDecoration
      child: Column(
        children: [
          SizedBox(height: MediaQuery.of(context).size.height / 10),

          Center(
            child: SvgPicture.asset("assets/images/ilab.svg", height: 50),
          ), // Center

          const SizedBox(height: 30),

          Text("Welcome Back ${widget.userType[0].toUpperCase()} + ${widget.userType.substring(1)}", style: TextStyle(
            color: Colors.white,
            fontWeight: FontWeight.w700,
            fontSize: 18,
          )),

          const Text("Sign in to your account", style: TextStyle(fontSize: 16, color: Colors.white, fontWeight: FontWeight.w400)),

          Expanded(
            child: Padding(
              padding: const EdgeInsets.symmetric(horizontal: 20, vertical: 10),
              child: ListView(
                shrinkWrap: true,
                children: [
                  const Text("Forgot Password?", style: TextStyle(color: Colors.white, fontWeight: FontWeight.w400)),
                  const Text("Don't have an account?", style: TextStyle(color: Colors.white, fontWeight: FontWeight.w400)),
                ],
              ),
            ),
          ),
        ],
      ),
    ),
  ),
);
```

Code for login page on the Mobile App

```
@override
Widget build(BuildContext context) {
  return Scaffold(
  backgroundColor: Colors.white,
  body: loading ? const LoadingIndicator() : GestureDetector(
    onTap: () => FocusScope.of(context).unfocus(),
    child: Form(
      key: _formKey,
      child: Container(
        decoration: const BoxDecoration(
          image: DecorationImage(
            image: AssetImage("assets/images/bg.jpg"),
            fit: BoxFit.cover,
          ), // DecorationImage
        ), // BoxDecoration
        child: Column(
          children: [
            SizedBox(height: MediaQuery.of(context).size.height / 12),

            Center(
              child: SvgPicture.asset("assets/images/ilab.svg", height: 50),
            ), // Center

            const Text("Welcome", style: TextStyle(fontSize: 20, color: Colors.white, fontWeight: FontWeight.w700)),
            const Text("Sign up to create your account", style: TextStyle(fontSize: 16, color: Colors.white, fontWeight: FontWeight.w400)),

            Expanded(
              child: Padding(

```

Code for sign-up page on the Mobile App.

```

class StudentHomePage extends StatefulWidget {
  const StudentHomePage({Key? key}) : super(key: key);

  @override
  State<StudentHomePage> createState() => _StudentHomePageState();
}

class _StudentHomePageState extends State<StudentHomePage> {

  int _selectedPageIndex = 0;
  static const List<Widget> pageOptions = <Widget>[

    StudentDashboard(),
    StudentCommunication(),
    StudentSubjects(),
    SettingsPage(),

  ]; // <Widget>[]

  void onTapped(int index) {
    setState(() {
      _selectedPageIndex = index;
    });
  }
}

```

Code for student home page on the Mobile App.

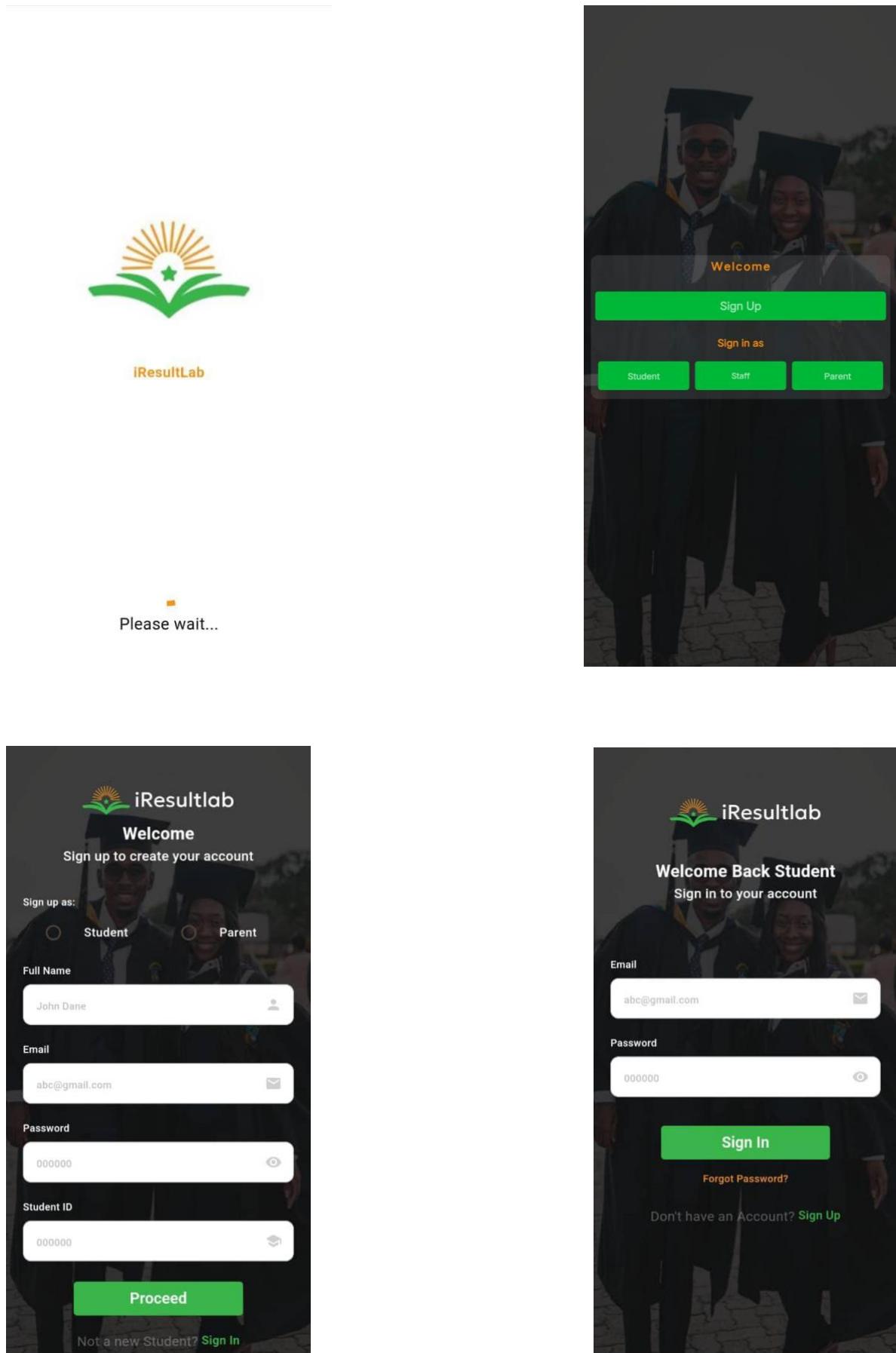
```

1
2  import 'package:firebase_core/firebase_core.dart';
3  import 'package:flutter/material.dart';
4  import 'package:i_result_lab/constants/colors.dart';
5  import 'package:i_result_lab/pages/splash_screen.dart';
6
7
8  void main() async{
9    WidgetsFlutterBinding.ensureInitialized();
10   await Firebase.initializeApp();
11   runApp(const MyApp());
12 }
13
14 class MyApp extends StatelessWidget {
15   const MyApp({super.key});
16
17   @override
18   Widget build(BuildContext context) {
19     return MaterialApp(
20       debugShowCheckedModeBanner: false,
21       theme: ThemeData(
22         colorScheme: ColorScheme.fromSeed(seedColor: mainColor),
23         useMaterial3: true,
24       ), // ThemeData
25       home: const SplashScreen(),
26     ); // MaterialApp
27   }
28 }

```

Code for the main page on the Mobile App.

Screen Shots from Deployed Mobile Application



Examination Schedule

05/02/2024 Monday	Physics	9:00 AM - 11:00 AM
06/02/2024 Tuesday	English Language	12:00 PM - 2:00 PM
07/02/2024 Wednesday	Economics	10:00 AM - 12:00 PM
08/02/2024 Thursday	Agricultural Science	2:00 PM - 4:00 PM
09/02/2024 Friday	Geography	9:00 AM - 11:00 AM
12/02/2024 Monday	Book keeping	10:00 AM - 12:00 PM
14/02/2024 Wednesday	Mathematics	9:00 AM - 11:00 AM
14/02/2024 Wednesday	Biology	12:00 PM - 2:00 PM
15/02/2024 Thursday	Chemistry	10:00 AM - 12:00 PM

Transcript Requests

Destination: international boarding school
Address of school: United kingdom
Country: United Kingdom
State: England
Request date: 21/01/2024
Request time: 10:39 AM
Request by: student

Add Subject

Class

JSS 1

Subject name

English language

Submit

Upload Result

Class

JSS 1

Student ID

000000

Student Name

John Dane

Term

1st Term

Subject

Mathematics

Score

50

Grade

Add Assignment

Class: JSS 1

Subject: Mathematics

Submission Date: Select Submission date

Submission Time: Select Submission time

Assignment content:

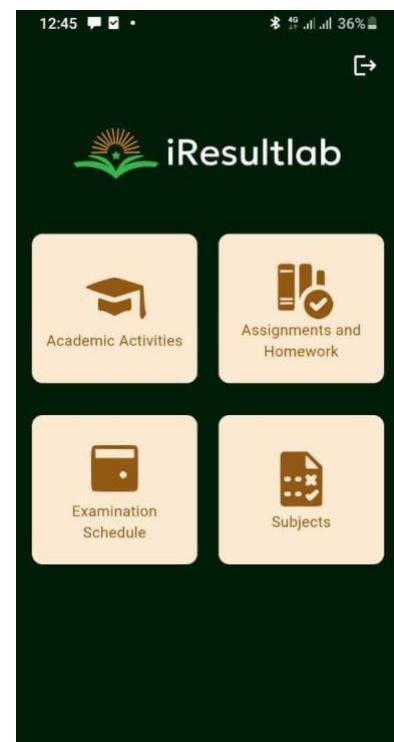
Submit



All Registered Students

Olaniba Olaoluwa
 Student ID: ME2020
 Student class: JSS 2
 Email: ola@gmail.com
 Gender: Male
 Mobile No: 09136115538
 Reg Date: 21/01/2024
 Reg Time: 12:07 PM
 Blood group: O-

Adegboyega Ayodeji M
 Student ID: HR2024
 Student class: SS 1 Science
 Email: ayus@gmail.com
 Gender: Male
 Mobile No: 08161289620
 Reg Date: 21/01/2024
 Reg Time: 10:37 AM
 Blood group: O+





Assignments Details

Assignment date: 21/01/2024
 Assignment Time: 11:36 AM
 Submission day: Tuesday
 Submission date: 13/02/2024
 Submission Time: 12:00 PM
 Assignment content:
 1. Why does geography important for learning?

Transcript Details

Kindly fill in the appropriate details below

Destination

Address

Country

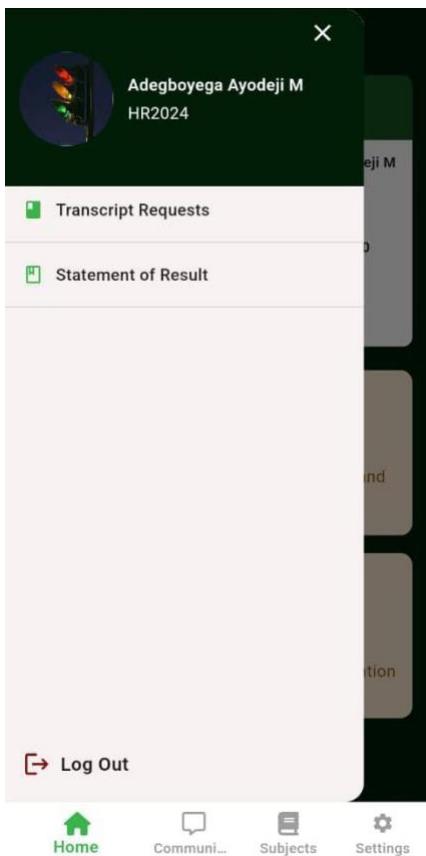
State

Submit

SS 1 Science Result

1st Term		
English	70	A
Agricultural Science	67	B
Mathematics	40	E
Geography	50	C
Physical Education	60	B
Economics	90	B
Chemistry	55	C
Biology	48	E
English Language	64	C

2nd Term		
Economics	62	B
Biology	70	A
Chemistry	62	B
Physics	53	C



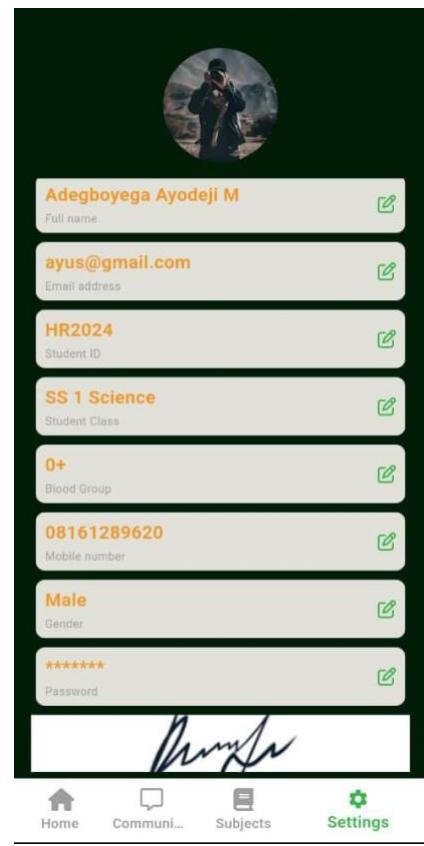
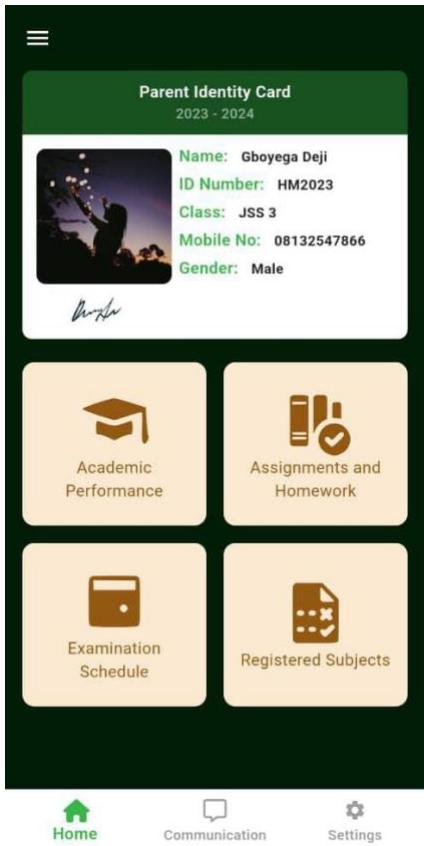
The screenshot displays two overlapping interfaces. On the left is a list titled 'My Registered Subjects' containing the following subjects:

- Geography
- Agricultural Science
- Economics
- Physics
- English Language
- Mathematics
- Chemistry
- Physical Education
- Biology

On the right is a 'Subject Registration' form with a title bar 'Subject Registration' and a back arrow. It includes a note 'Select the subjects for the year' and a list of subjects with checkboxes:

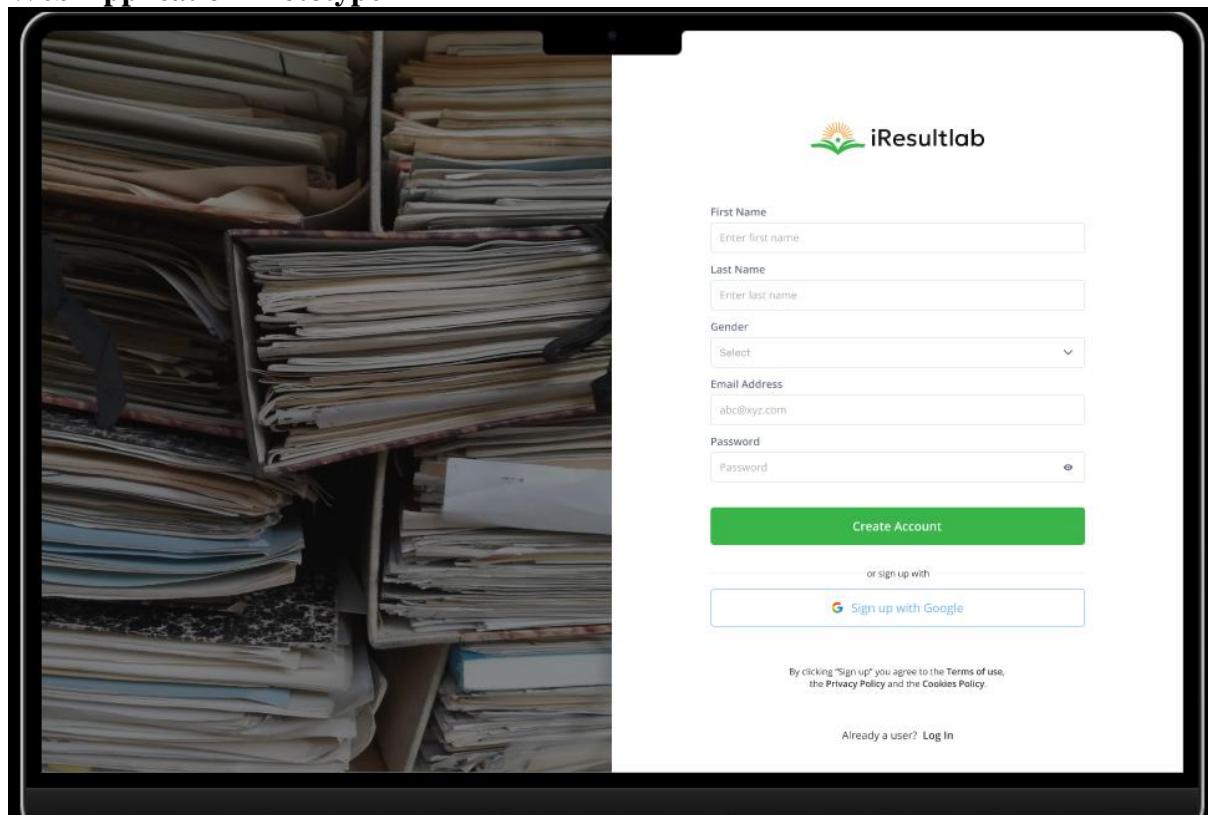
Subject	Selected
Biology	<input checked="" type="checkbox"/>
Physical Education	<input checked="" type="checkbox"/>
Chemistry	<input checked="" type="checkbox"/>
Mathematics	<input checked="" type="checkbox"/>
English Language	<input checked="" type="checkbox"/>
Physics	<input checked="" type="checkbox"/>
Economics	<input checked="" type="checkbox"/>
Book keeping	<input type="checkbox"/>
Agricultural Science	<input checked="" type="checkbox"/>
Geography	<input checked="" type="checkbox"/>

At the bottom right is a large green 'Submit' button.

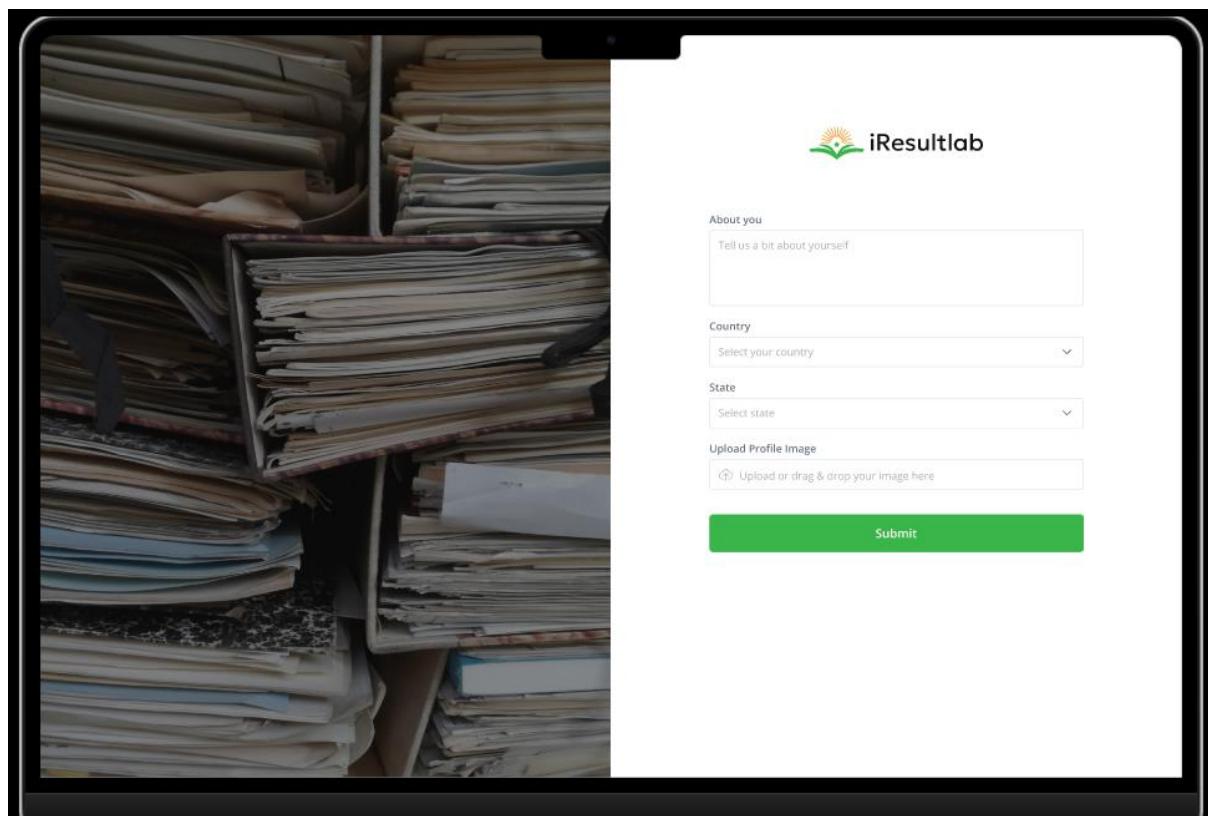


Appendix L: ASRMS Web Application Prototype Screenshot

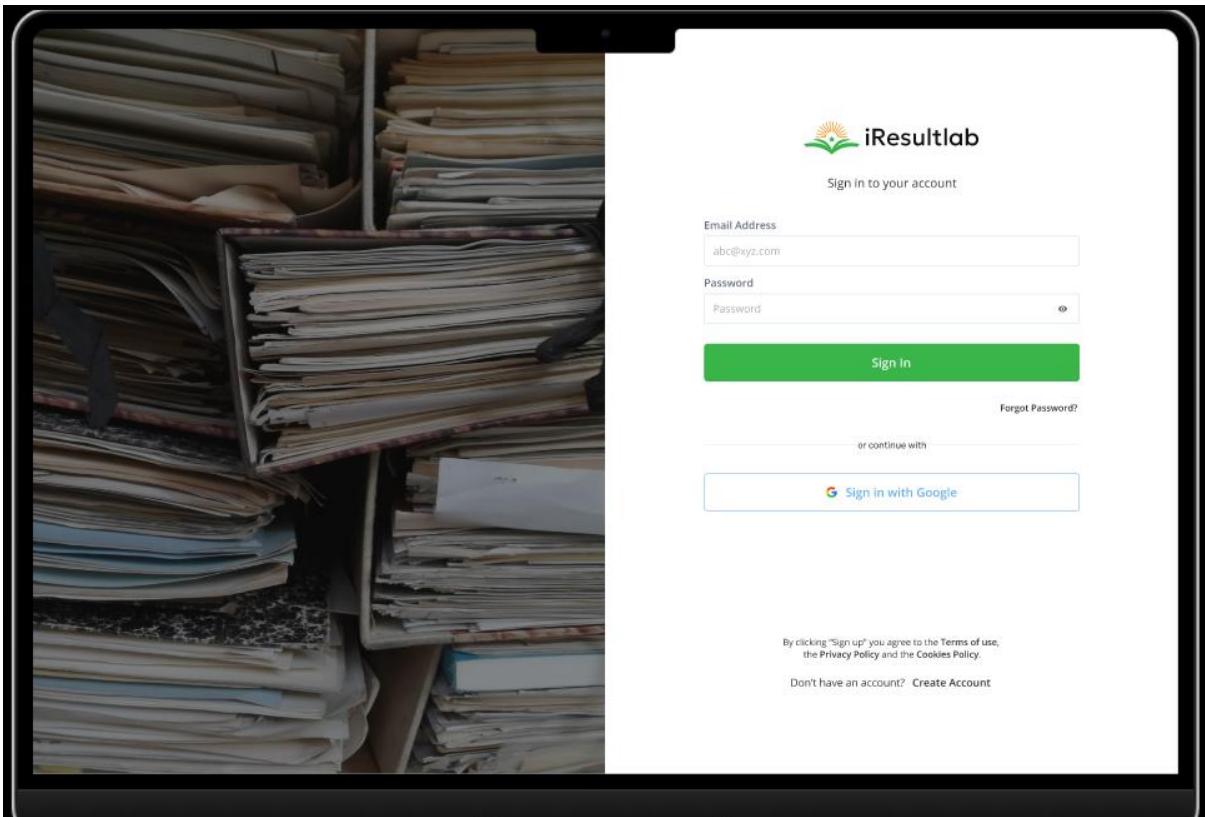
Web Application Prototype



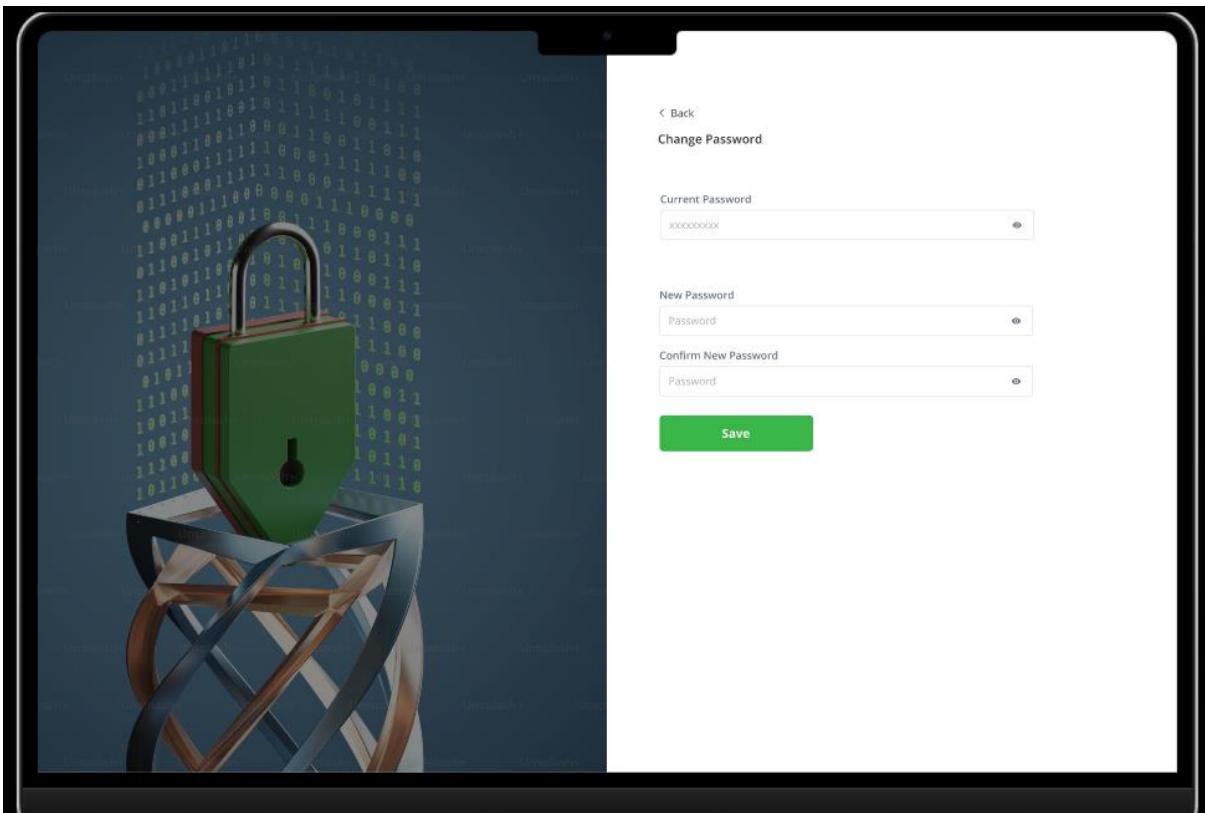
User Registration Page



User Profile Creation



User Account Sign in



Change Password for user.



College of Business,
Technology and
Engineering

Research Skills and Dissertation Module (55- 706556).

PUBLICATION PROCEDURE FORM

In this module, while you create your own research question or topic area, your supervisor makes a significant intellectual contribution to this work as the research progresses. Your supervisor will make the decision on whether your work merits publication based on the quality of the work you have produced. Your supervisor will co-author the paper for publication with you and your supervisor will both be listed as authors. You are required to sign the declaration below to confirm that you understand and will follow this procedure.

Declaration:

I Akintunde Ogunyemi confirm that I understand and will comply with the Publication Procedure outlined in the Module Handbook and the Blackboard Site.		
Student:	Signature 	Date 23 rd January, 2024
Supervisor:	Signature 	Date 23 rd January, 2024