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# Development of a Web-based SIWES Logbook Management System with Secure Authentication and Role-based Access: A Case Study of Federal University of Technology, Akure, Ondo State

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### ABSTRACT

The Student Industrial Work Experience Scheme (SIWES) is designed to connect classroom learning with real-world workplace experience across Nigerian universities. A central component of this process is the logbook, which students use to record their daily tasks and on which supervisors rely for evaluation. In many Nigerian institutions, these logbooks are still kept on paper, a familiar practice that often leads to delays, lost records, and other inefficiencies. To address these challenges, this study aims to design and implement a secure, role-based, multi-user, web-enabled SIWES logbook system to streamline documentation, supervision, and evaluation, with the objectives of improving accessibility, enhancing security through authentication, and enabling real-time monitoring for all stakeholders. The system was developed using the Waterfall Software Development Life Cycle (SDLC) and a four-tier architecture comprising a React.js presentation layer, Node.js application layer, MySQL data layer, and a security layer employing Bcrypt for password hashing and JSON Web Tokens (JWT) for stateless authentication, alongside Role-Based Access Control (RBAC) for tailored permissions. A user evaluation with 40 participants at the Federal University of Technology, Akure, demonstrated high usability, security, and adoption: 65% were very satisfied, 72.5% found navigation easy, 57.5% rated the system as very secure, and 95% preferred it over paper-based logbooks. These findings confirm that the proposed system enhances monitoring, ensures data integrity, and provides timely feedback, offering a practical, centralized, and secure alternative to traditional SIWES logbooks.

**Keywords:** SIWES, web-based logbook, role-based access, system security, usability

### Introduction

The Student Industrial Work Experience Scheme (SIWES) is a mandatory Nigerian program that provides undergraduates with practical industrial experience, enhancing technical competence and employability (Nawaya and Jemimah, 2019). Traditionally, SIWES participation is documented using paper-based logbooks, which are often

inefficient, prone to delays, and susceptible to loss or damage (Adetiba *et al.*, 2012).

Web-based systems have been increasingly adopted in education and training due to their accessibility, scalability, and efficiency. Digital logbooks have been introduced as a way to support real-time data entry, instant feedback, and continuous monitoring, helping to reduce administrative workload and improve the accuracy of records (Omonijo *et al.*, 2020; Olojakpoke

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and Ojo, 2020; Olasehinde *et al.*, 2022; Nugraha *et al.*, 2023; Adekunle *et al.*, 2024; Danganana *et al.*, 2025). However, most existing solutions prioritize usability over security, leaving data vulnerable to breaches. Robust security mechanisms, such as Role-Based Access Control (RBAC), encryption, and secure authentication, are therefore critical to maintain trust and integrity in digital educational platforms (Almorsy *et al.*, 2016).

Against this backdrop, this study proposes the design and development of a secure, role-based, web-enabled SIWES logbook and management portal, using the Federal University of Technology, Akure (FUTA), as a case study. The system aims to digitize the entire logbook process, enable real-time supervision, enhance security, and improve the overall efficiency of SIWES logbook activity management.

## Literature and System Overview

SIWES is a mandatory program in Nigerian higher education institutions that integrates academic learning with hands-on industrial practice. At FUTA, the research case study institution, the existing system for managing SIWES Logbook activities is completely paper-based. Students receive physical logbooks to document their daily activities, tasks, sketches, and observations during their industrial training. Supervisors, both industry-based and school-based, review these logbooks and provide comments. School-based supervisors also conduct physical visits to students' training locations to monitor and assess. Although this traditional approach is familiar and does not require internet connectivity, it suffers from significant drawbacks:

- i. High operational costs due to printing and distribution of logbooks.
- ii. Risk of loss or damage, which can lead to penalties for students.
- iii. Limited supervision and monitoring, as physical visits are constrained by distance and large student-to-supervisor ratios.
- iv. Delayed feedback and assessment, reducing

program efficiency.

- v. Environmental concerns due to paper consumption.

These challenges highlight the need for a modern, secure, and efficient alternative. Several studies have explored digital approaches to improve SIWES management. Adetiba *et al.* (2012) developed the e-SIWES portal to automate registration and logbook entries. Zachariah and Yabuwat (2016) proposed web and cloud-based platforms for supervision and collaboration. Olojapoke *et al.* (2020) developed a mobile application, and Hadi *et al.* (2020) designed an online supervision system (logbook) with the Laravel framework. However, most of these works were either conceptual or limited in scope, lacking robust security, role-based access control, and comprehensive evaluation. Some faced challenges related to scalability, user adoption, and vulnerability to cyber threats.

This research proposes the development of a web-based SIWES logbook management system with secure authentication and role-based access control, using FUTA as a case study. The system serves as a centralized online platform for recording and managing SIWES logbook activities, offering the following advantages over the existing paper-based system:

- i. Secure Authentication and Role-based Access to ensure data privacy and controlled user permissions for students, supervisors, and administrators.
- ii. Real-time supervision and monitoring, eliminating delays caused by physical visits.
- iii. Enhanced data security, preventing loss or damage of records.
- iv. Efficient organization and search functionality, enabling quick retrieval of student logs.
- v. Cost reduction by eliminating paper usage and minimizing travel requirements.
- vi. Scalability and flexibility, supporting future integration with institutional systems.

By addressing the limitations of both the current paper-based system at FUTA and previous digital attempts, this proposed solution provides a modern, secure, and efficient framework for managing SIWES activities.

### Materials and Methods

The secure SIWES web-based logbook system was developed using the waterfall software development

life cycle (SDLC), which follows five sequential phases: requirements analysis, system design, implementation, testing, and deployment. In the requirements analysis phase, a detailed study of the existing paper-based logbook system currently used at FUTA was conducted to identify its structure, fields for daily activity recording, comment sections for supervisors, and limitations. These informed the requirements for user roles, security expectations, and preferred functionalities.

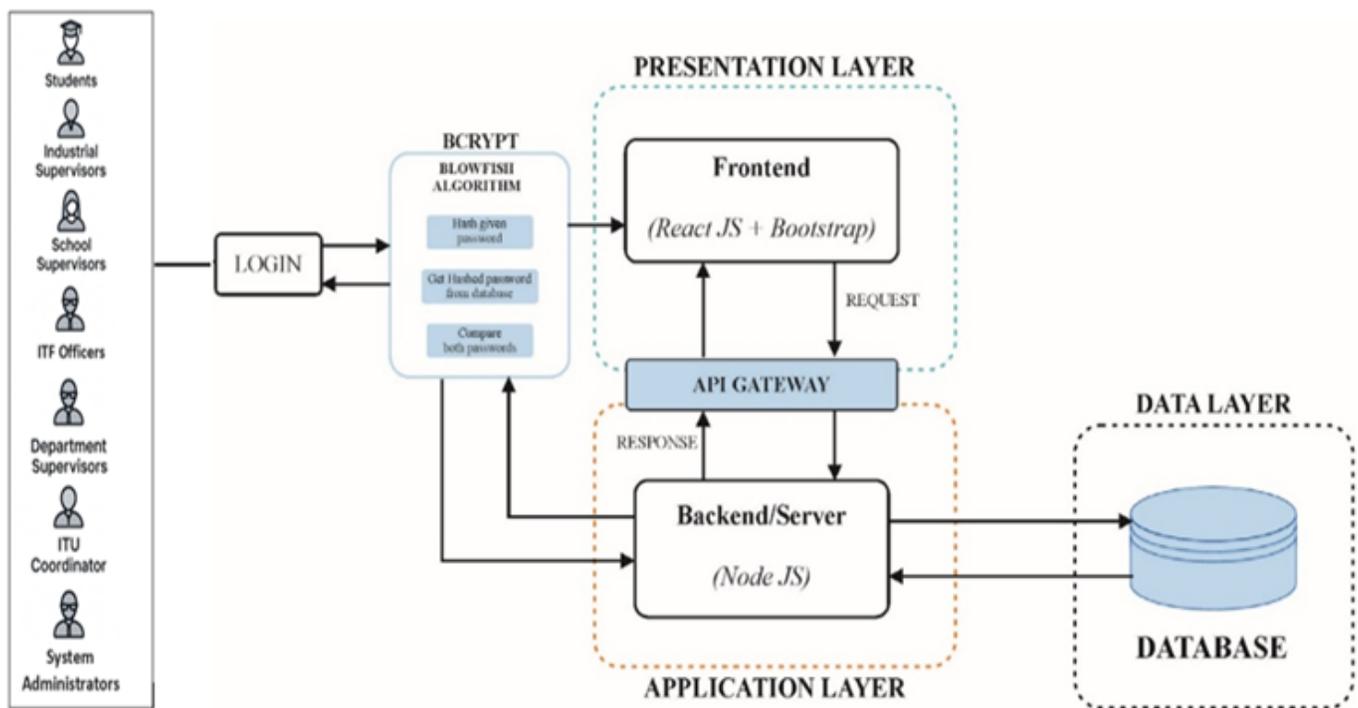


Figure 1. Secure Web-based Logbook System Architecture

The system design phase involved creating a four-tier architecture (Figure 1) comprising the presentation, application, data, and security layers.

The presentation layer was developed using React.js and provides an interactive interface that reflects the needs of each user group. Access to the various features is controlled through Role-Based Access Control (RBAC), ensuring that students, industrial supervisors, school supervisors, ITF officers, departmental supervisors, ITU coordinators, and administrators can only view and perform actions

appropriate to their roles (Figure 2).

The application layer, built with Node.js, handles the system’s core logic and operations, and its structure and behaviour are illustrated in the class diagram (Figure 3).

The data layer, implemented in MySQL, manages entities, attributes, and relationships within a relational schema (Figure 4).

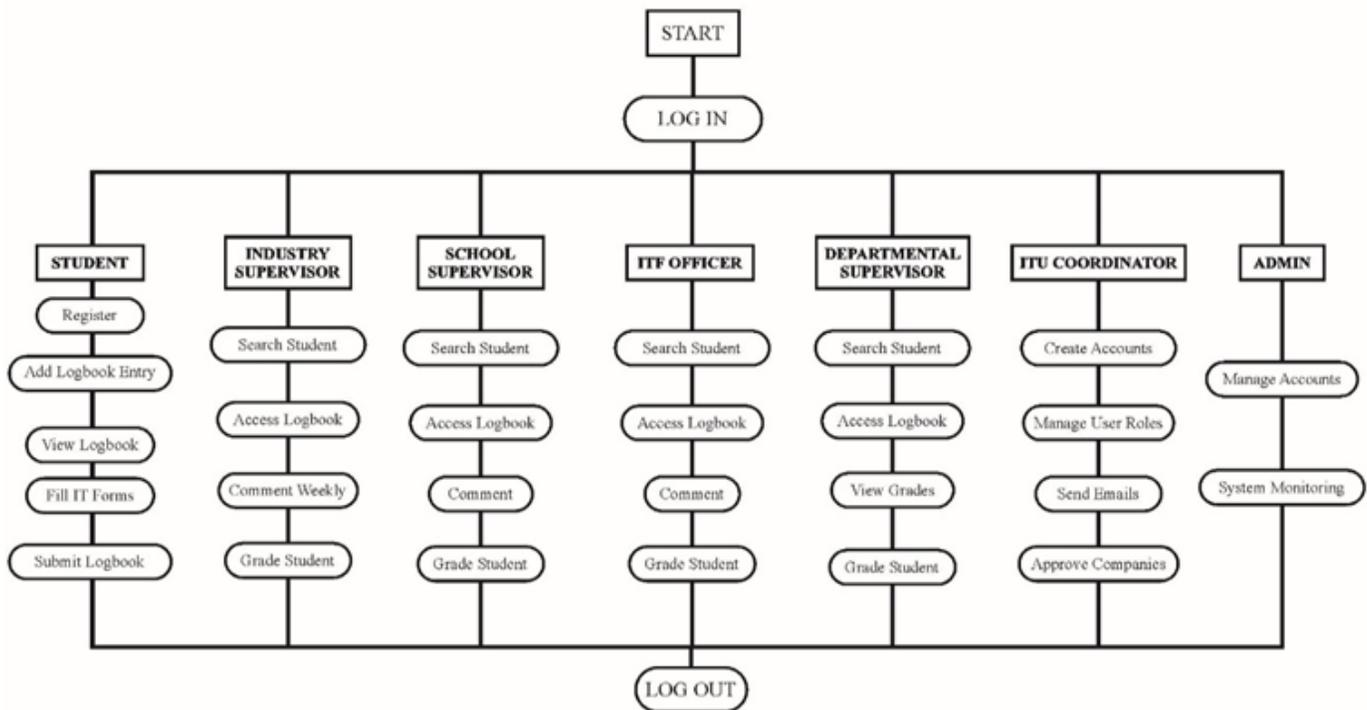


Figure 2. Secure Web-based Logbook System Users’ Roles Flowchart

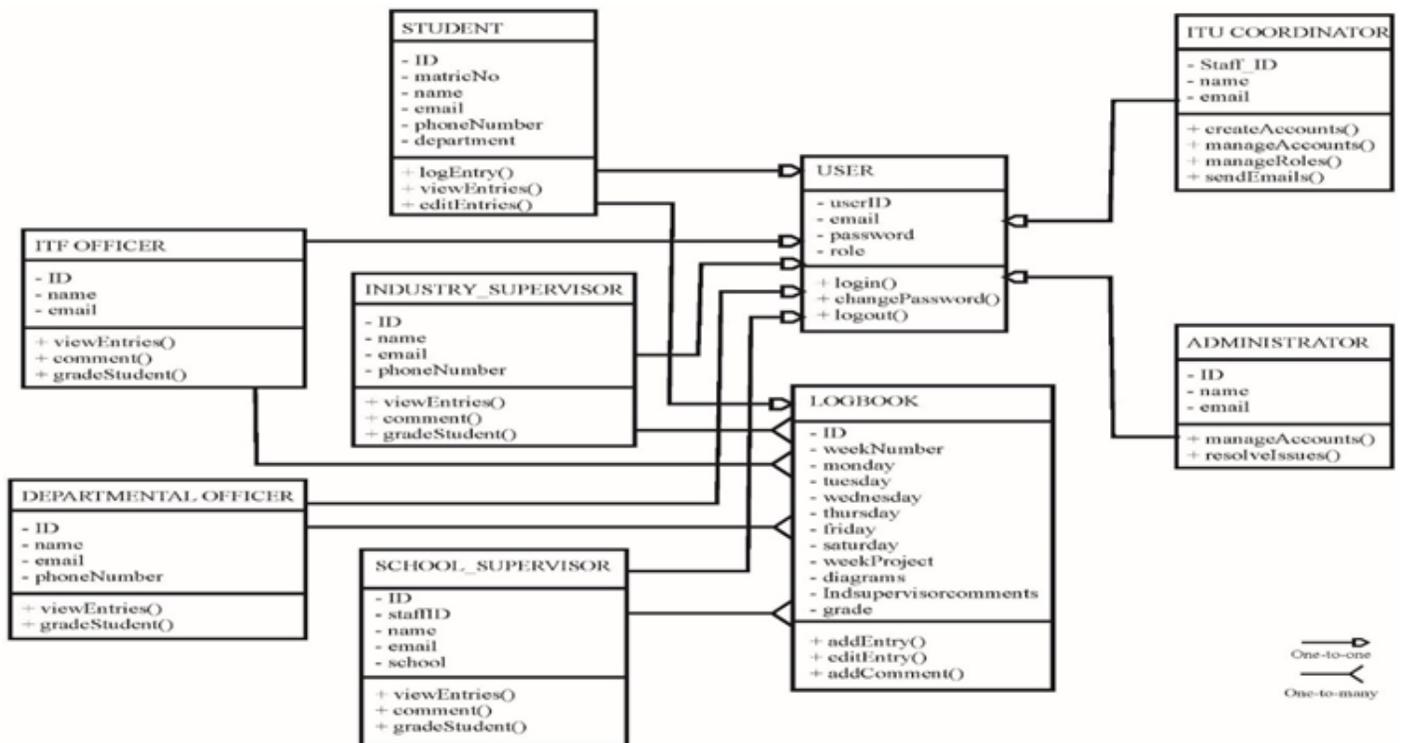


Figure 3. Secure Web-based Logbook System Class Diagram

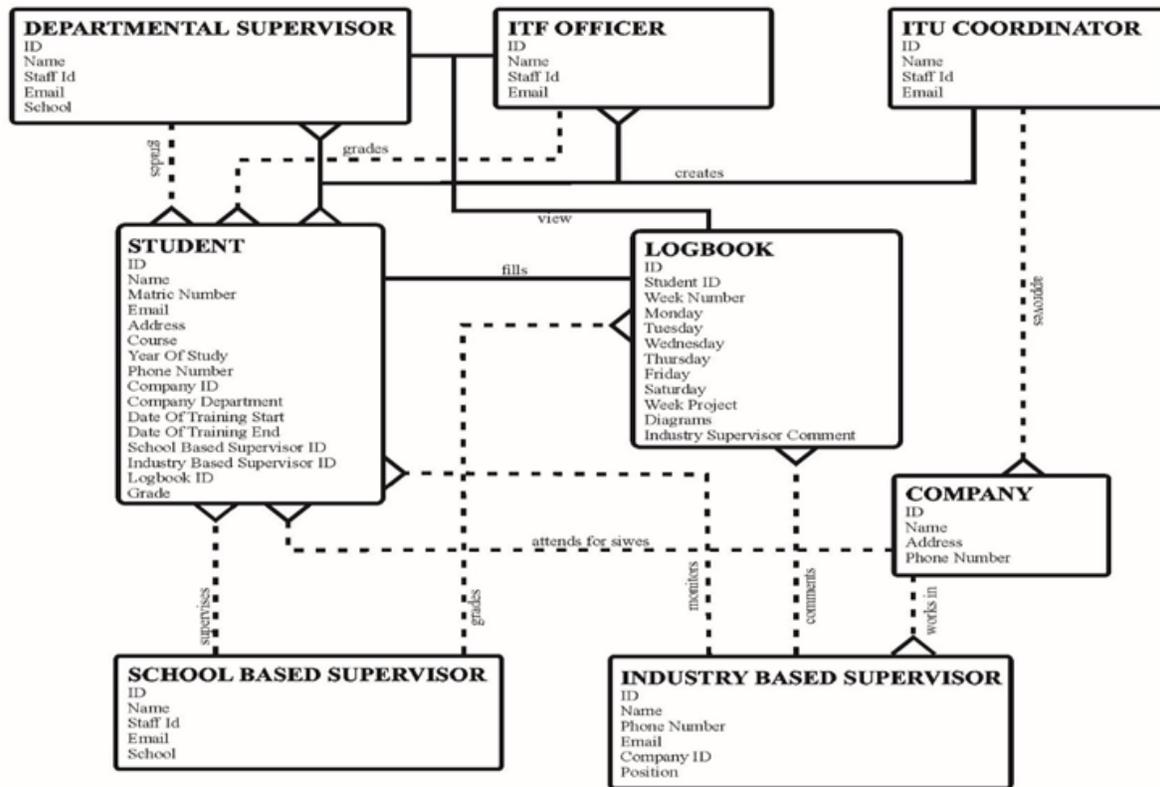


Figure 4. Entity Relationship diagram

The security layer of the SIWES web-based logbook system incorporates password protection, stateless authentication, and role-based access control. By combining Bcrypt, JSON Web Tokens (JWT), and Role-Based Access Control (RBAC), the system establishes a secure and scalable security framework. Passwords are hashed using Bcrypt (Provos and Mazieres, 1999), a salted algorithm based on the Blowfish cipher (Figure V), defined in Equation (1).

$$H = \text{Bcrypt}(P,S) \tag{1}$$

where  $H$  is the hashed password,  $P$  is the plaintext password, and  $S$  is a randomly generated salt. This method mitigates brute-force and rainbow-Table attacks, thereby ensuring secure credential storage.

Upon login, a JWT is generated to authenticate the user without relying on server-side sessions (Dalimunthe *et al.*, 2023), JWT enables secure, server-independent

session validation as described in Equation (2):

$$T = \text{JWT}(H,C,\text{exp}) \tag{2}$$

where  $H$  is the hashed password,  $C$  contains user claims and role information, and  $\text{exp}$  denotes the token expiration time.

RBAC restricts system functionalities to authorized users (Ferraiolo *et al.*, 1999), as expressed in Equation (3):

$$A(u,r,f) = \begin{cases} 1, & \text{if } r \in R_u \text{ and } f \in F_r \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

where  $A(u,r,f)$  is the access permission for the user  $u$  with role  $r$  to functionality  $f$ ,  $R_u$  is the set of roles assigned to the user, and  $F_r$  is the set of functions accessible to the role  $r$ .

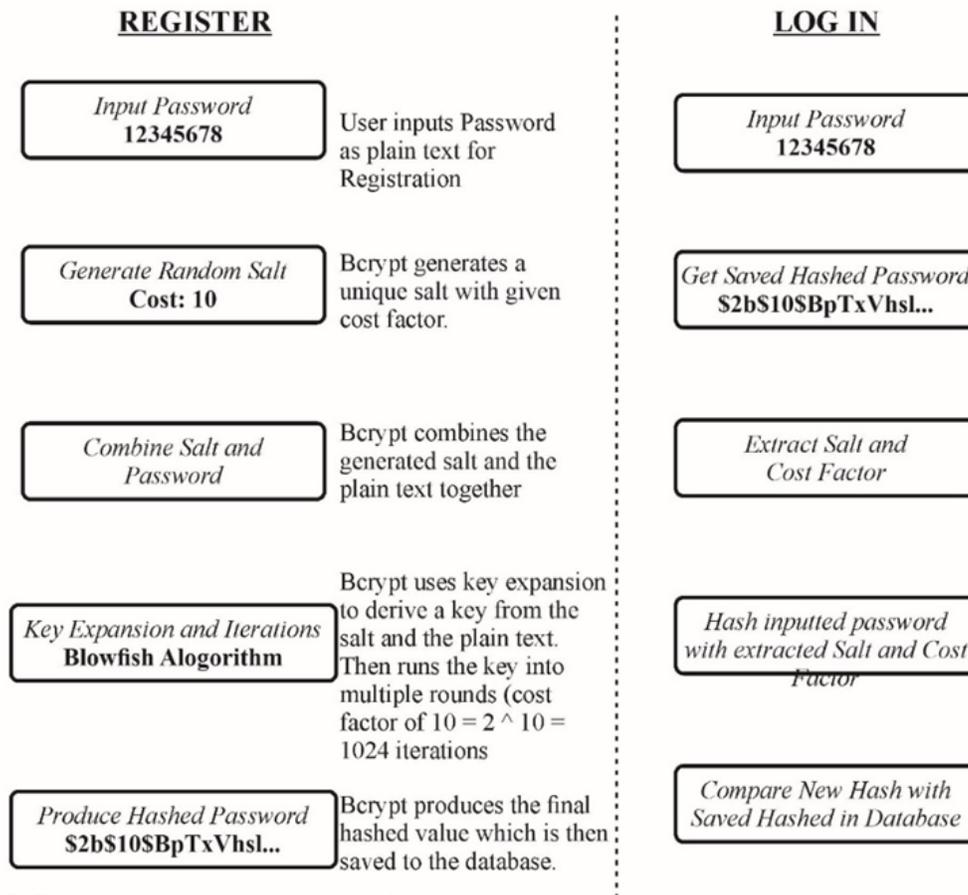


Figure 5. Bcrypt process for login and sign-up

The complete security workflow can thus be summarized in Equation (IV). This ensures that only authenticated users with the appropriate role can access specific functionalities.

$$A(u, r, f) \Leftrightarrow \text{verify}(T) \wedge (r \in R_u \wedge f \in F_r) \quad (4)$$

The implementation phase involved building the frontend with React.js to deliver a dynamic, responsive user interface, while the backend was developed in Node.js and connected via RESTful APIs for seamless data exchange. The database schema was set up in MySQL to securely store logbook entries, user information, and authentication data. Testing was conducted in multiple stages: unit testing to verify individual modules, such as authentication and

logbook entry; integration testing to ensure seamless interaction between system components; and user acceptance testing (UAT) with 40 participants, comprising students, school supervisors, and industry supervisors. This testing validated usability, security, and role-specific functionality.

Deployment was carried out in a temporary test environment using a secure local server setup with HTTPS enabled. This arrangement allowed stakeholders to access the system for demonstrations and testing without requiring complete production hosting. The temporary deployment also supported user acceptance testing and evaluation while maintaining data security throughout the trial period.

Finally, system evaluation was performed using a

structured survey that combined Likert-scale and open-ended questions. The evaluation assessed usability, ease of navigation, clarity of instructions, perceived security, and overall effectiveness compared to the traditional paper-based logbook system. Feedback from participants provided insights into user satisfaction, adoption preferences, and areas for improvement.

## Results and Discussion

The developed SIWES web-based logbook system centralizes and digitizes the entire logbook management process, providing dedicated portals for students, industrial supervisors, school supervisors, ITF officers, departmental supervisors, ITU coordinators, and administrators (Figures. 6–14). New users register through the Submit Details page (Figure 6), after which they complete email verification approved by an administrator and create secure passwords. These passwords are hashed using Bcrypt, which incorporates the Blowfish algorithm, helping to protect against brute-force and rainbow-Table attacks. Session management is handled

email-based login for industry supervisors and administrators, supporting role separation and secure

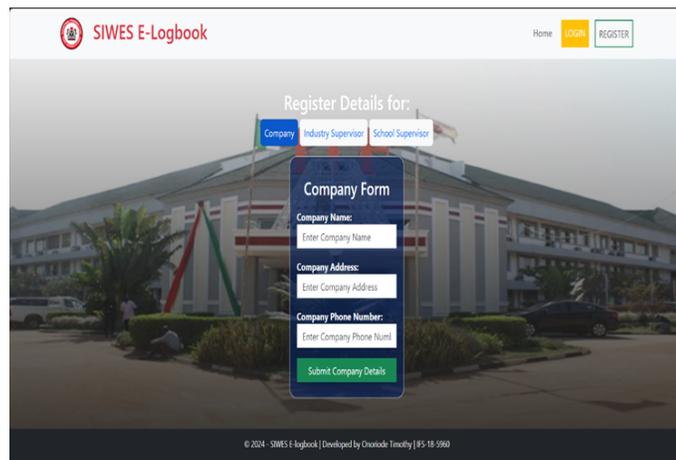


Figure 6. Screenshot of Registration Page

with JSON Web Tokens (JWT), enabling stateless authentication and reducing the system’s dependence on server-side session storage.

The Login Page (Figure 7) enforces unique identifiers for each user category, matriculation numbers for students, staff IDs for school supervisors, and

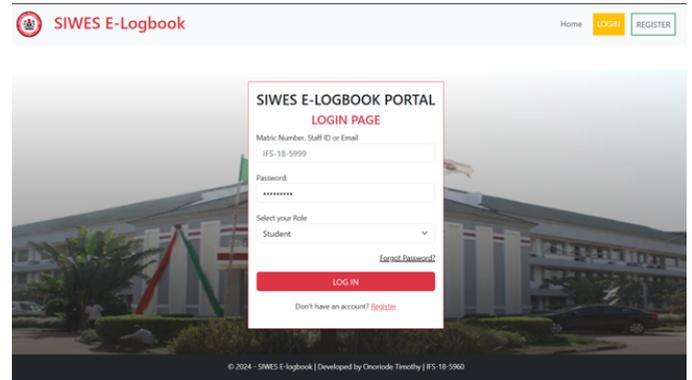


Figure 7. Screenshot of Login Page

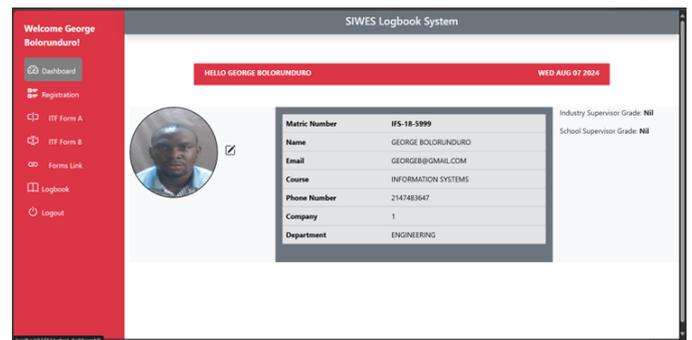


Figure 8. Screenshot of Student Dashboard Page

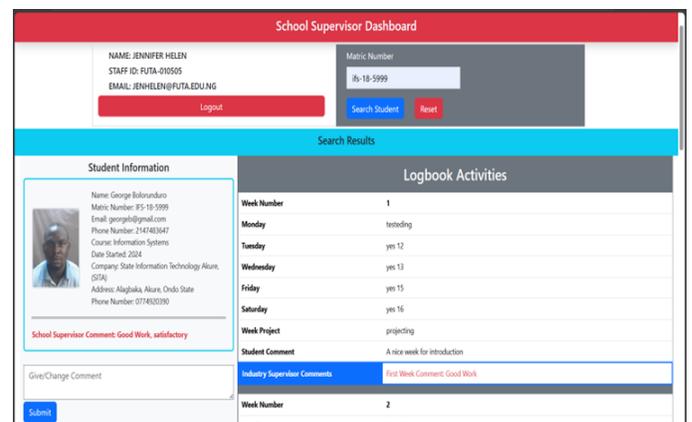


Figure 9. Screenshot of School Supervisor Page

access. Authenticated dashboards for each user (Figs. 8–14) provide user-specific functionality. The students submit their reports and supporting evidence of SIWES activities, while industrial-based supervisors

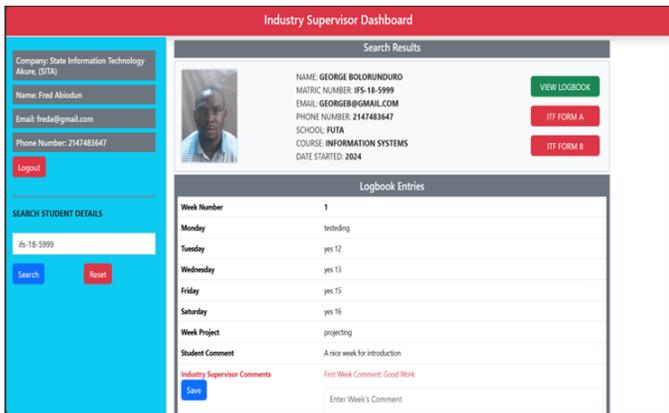


Figure 10. Screenshot of Industry Supervisor Page

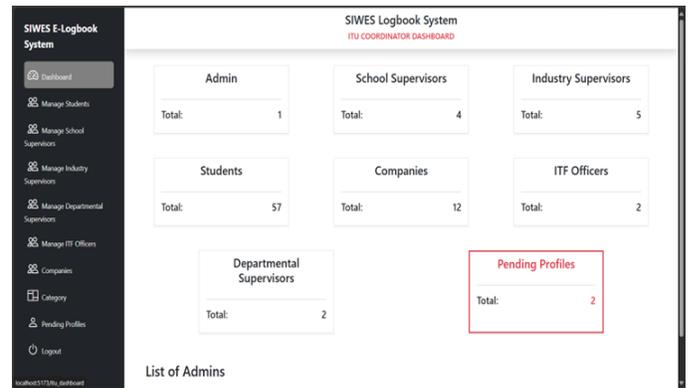


Figure 13. Screenshot of ITU Coordinator Dashboard Page

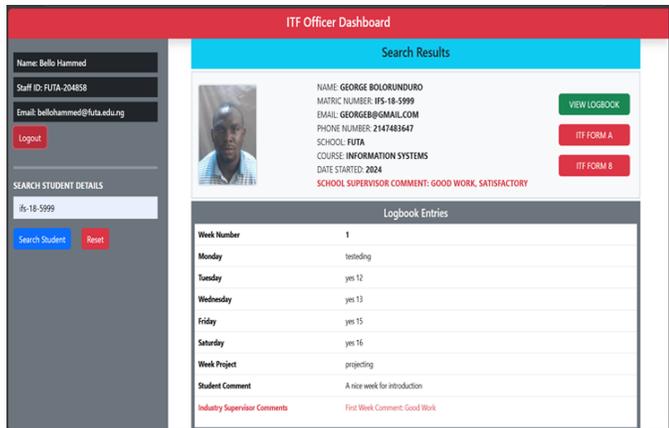


Figure 11. Screenshot of ITF Officer Dashboard Page

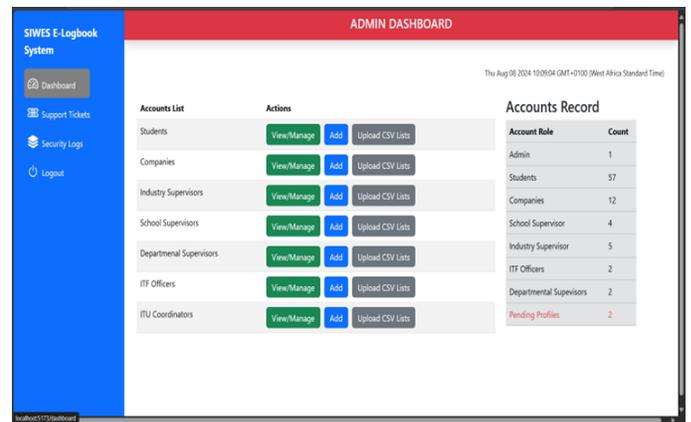


Figure 14. Screenshot of Admin Dashboard Page

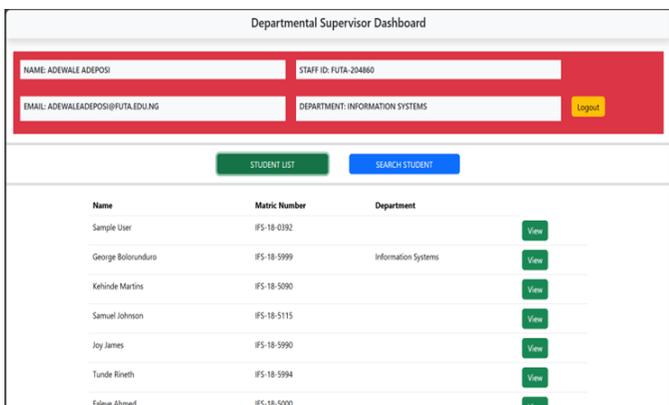


Figure 12. Screenshot of Departmental Supervisor Page

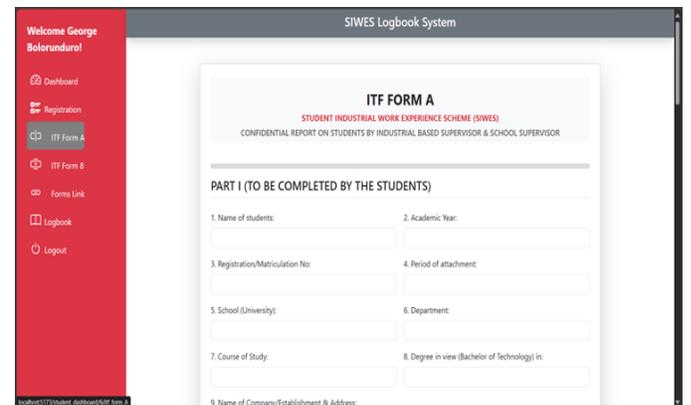


Figure 15. Screenshot of ITF Form A

review these entries, provide weekly feedback, and assign 80% of the grade using Form A (Figure 15). School supervisors verify performance and grade the remaining 20% based on industrial-based

supervisors' evaluations. ITF officers validate these entries, review Form 8 (Figure 16), and sign off on training activities, while departmental supervisors monitor all reports to inform logbook grading. ITU

coordinators facilitate stakeholder coordination, and administrators manage accounts, system monitoring, and backups. This workflow adheres to RBAC principles, ensuring controlled access and enhancing

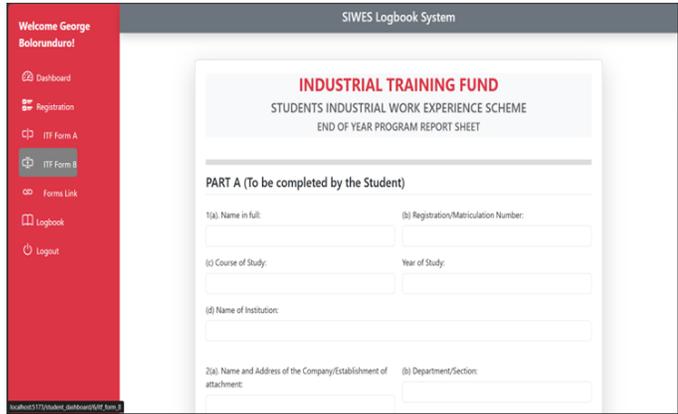


Figure 16. Screenshot of ITF Form 8

data security.

In this study, user evaluation was conducted with 40 participants in a temporary test environment using a structured survey. The survey consisted of open-ended questions assessing system effectiveness, user satisfaction, ease of use, security, and user preferences and adoption. Responses were analysed directly in Google Forms using participant submissions, and the findings provide valuable insights (Figures. 17–22).

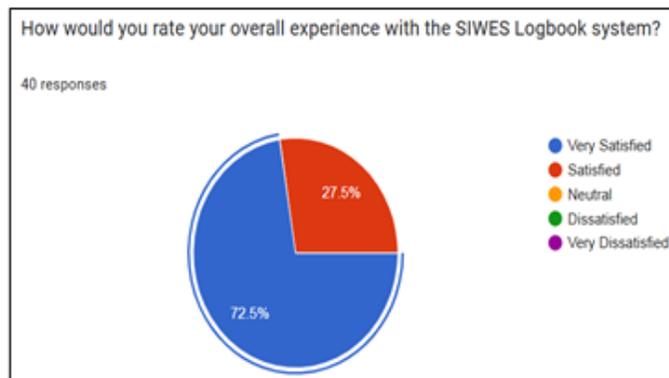


Figure 17. User Experience

Results indicate high satisfaction: 65% were very satisfied, 72.5% found navigation easy, and 100% reported ease of learning. Activity logging was rated “very easy” by 48%, while \*\*57.5% and 42.5% considered the system “very secure” and “secure,” respectively. Notably, 95% preferred the web-based

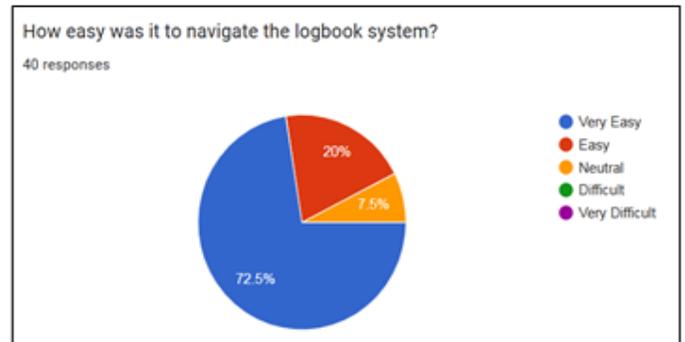


Figure 18. Ease of Use and Navigation



Figure 19. User Interactions

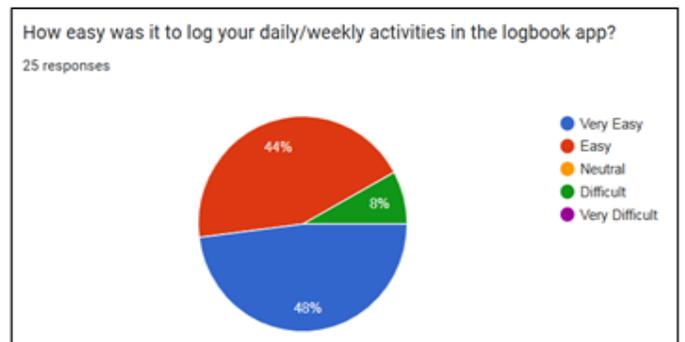


Figure 20. Ease of Logging Activities

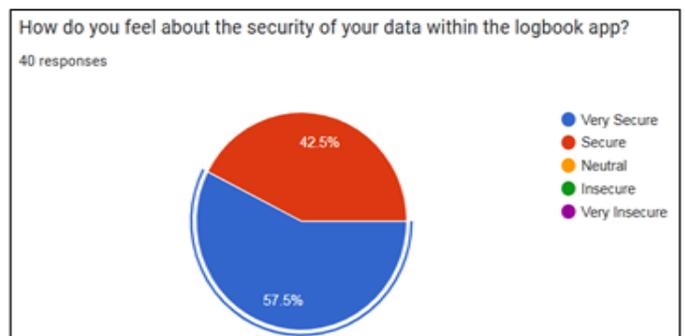


Figure 21. Data Security

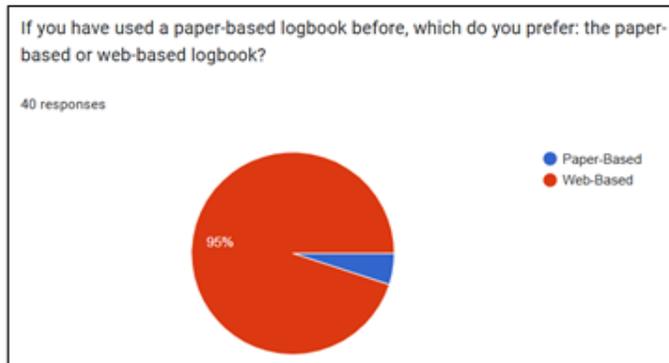


Figure 22. Web-based Preference system over paper-based logbooks.

These findings align with prior studies that show that digital platforms enhance usability, transparency, and communication in academic supervision. Positive perceptions of security support research emphasizing strong authentication and cryptographic protection in educational platforms (Bonneau *et al.*, 2012), and preference for the web-based system reflects trends toward digital solutions that reduce administrative overhead and enhance data accessibility (Al-Fraihat *et al.*, 2020).

Although the system demonstrated strong usability and security in a controlled test environment, its deployment was temporary and limited to selected participants. Future work will focus on full-scale implementation, integration with institutional databases, and extended security audits to ensure compliance with industry standards.

Overall, the integration of Bcrypt, JWT, and RBAC provides a balance between secure password management, efficient authentication, and controlled access. The system demonstrates both technical robustness and strong user acceptance, offering a practical, centralized, and secure alternative to traditional paper-based SIWES logbooks.

## Conclusion

This study developed a secure web-based SIWES logbook system using a four-tier architecture

comprising presentation, application, data, and security layers with React.js, Node.js, MySQL, Bcrypt, and JWT. The system addresses limitations of traditional paper-based logbooks by providing centralized, secure, and role-specific access for all stakeholders. A user evaluation of 40 participants, using FUTA as a case study, demonstrated high acceptance: 65% were very satisfied, 72.5% found the system easy to navigate, 100% reported ease of adoption, 95% preferred it over paper-based systems, and 57.5% rated it very secure. The integration of Bcrypt for password hashing, JWT for stateless authentication, and RBAC for controlled access ensured both technical robustness and user confidence. Although the evaluation was limited to a single university and a modest sample size, the system shows promise for broader deployment.

## Recommendations for Future Work:

1. Develop a mobile application to enable field access and improve flexibility for students and supervisors.
2. Integrate the system with the Industrial Training Fund (ITF) national database for centralized reporting and compliance.
3. Apply machine learning techniques for predictive analytics and performance insights based on logbook data.
4. Enhance user experience through real-time notifications, offline access, and interactive visualizations for better engagement.
5. Conduct full-scale deployment across multiple institutions and perform extended security audits to ensure compliance with industry standards.

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