

**University of Ibadan Journal of
Science and Logics in ICT
Research (UIJSLICTR)
ISSN: 2714-3627**

A Journal of the Faculty of Computing, University of Ibadan, Ibadan, Nigeria

Volume 16 No. 1, January 2026

**journals.ui.edu.ng/uijslictr
<http://uijslictr.org.ng/>
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Cloud-Based Logbook-as-a-Service for Student Industrial Work Experience Scheme (SIWES) in Nigerian Institutions

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Abstract

The Student Industrial Work Experience Scheme (SIWES) is a crucial component of technical and vocational education in Nigerian institutions, designed to bridge the gap between classroom learning and industry practice. However, traditional SIWES logbooks, maintained in paper format, pose challenges such as limited accessibility, data loss, and difficulty in leveraging documented experiences for analytics and grading. This study presents the design and development of a Cloud-Based Logbook-as-a-Service (LaaS) for SIWES, enabling real-time documentation, retrieval, and analysis of students' industrial experiences. The system has an integrated assessment module to grade student performance based on logged activities and feedback from industry supervisors. This study provides a system that fosters digital transformation on SIWES documentation and grading processes by providing a centralized, scalable, and accessible platform, this innovation enhances the efficiency of SIWES evaluation and fosters data-driven decision-making for academic and industry stakeholders. To assess the usability of the developed platform, the system was evaluated based on user experience and task completion time. The overall system performance, measured using these metrics, indicated positive outcomes.

Keywords: *Classification algorithm, Data mining, Decision tree, Naïve Bayes, k-nearest neighbour*

1. Introduction

The Students Industrial Work Experience Scheme (SIWES) is a skills training program initiated by the Industrial Training Fund (ITF) in Nigeria to bridge the gap between theoretical knowledge and practical experience [1]. It provides university students with opportunities to apply their classroom knowledge in real-world industrial settings, thereby equipping them with technical skills and hands-on experience relevant to their fields of study [2]. SIWES is an integral component of the curriculum in professional disciplines across Nigerian higher institutions, serving as a compulsory internship program that students must complete before graduation [3]. Through this program, students gain exposure to modern workplace environments, industrial equipment, and technical expertise that may not be available within their institutions [4].

According to Adeosun et al., [5] A critical aspect of SIWES is the logbook, which students use to document their daily activities, tasks completed, challenges faced, and knowledge acquired during the internship. However, the traditional manual logbook system has several operational inefficiencies. Students frequently forget to update their logs, leading to inaccurate or incomplete records. Furthermore, paper-based logbooks are prone to damage, misplacement, and tampering, making it difficult for institutions and industry supervisors to track progress effectively [6]. The reliance on physical logbooks also delays assessment since institutions must wait for the return of completed logs before evaluating students' industrial training experiences. These limitations highlight the urgent need for an automated solution that leverages modern technology for efficient data management, real-time monitoring, and secure documentation [3].

To address these challenges, this study proposes a Cloud-Based Logbook-as-a-Service (LaaS) model for the SIWES program. Unlike

Oladipo O., Ojo O. S., Ogunwale Y. E., Adigun J.O. and Oyinloye O. A. (2026). Cloud-Based Logbook-as-a-Service for Student Industrial Work Experience Scheme (SIWES) in Nigerian Institutions. *University of Ibadan Journal of Science and Logics in ICT Research (UIJSLICTR)*, Vol. 16 No. 1, pp. 132 - 142

standalone computerized systems, which may still have local storage limitations and accessibility issues, a cloud based SIWES logbook offers real-time access, automatic backups, and seamless collaboration between students, supervisors, and institutions. This development ensures that logbook entries are instantly available online, allowing institutions and employers to monitor student progress in real-time, thereby improving oversight and assessment efficiency.

Cloud-based LaaS offers several advantages over traditional digital logbooks. As it enables multi-user access, allowing students, institutional supervisors, and industry-based mentors to update and review logs from anywhere, at any time, using internet-enabled devices [7]. In addition, it fosters data security and integrity are ensured through authentication mechanisms, encryption, and role-based access control (RBAC) [8]. This prevents unauthorized alterations and ensures that only authorized individuals can view or edit specific sections of the logbook. Also, the scalability of cloud platforms means institutions can handle large volumes of logbook data without investing in expensive physical servers [9].

A Cloud-Based SIWES Logbook integrates modern cloud computing services such as SaaS (Software-as-a-Service) and PaaS (Platform-as-a-Service) to provide an intuitive, web-based responsive logbook system. The system enables Automated Daily Logging, allowing students to record their daily tasks using structured digital templates that are accessible anytime through the secure web portal. The Real-Time Feedback, where the supervisors can track student activities and run an assessment if need be and this is done instead of waiting for manual submissions. All data is automatically backed up to secure cloud servers, ensuring complete protection against loss or damage to physical logbooks. In addition, the system seamlessly integrates with existing academic management platforms to support automated grading and reporting.

This study aims to design and implement a Cloud-Based Logbook-as-a-Service (LaaS) platform to automate record-keeping and monitoring for SIWES students.

The specific objectives are:

1. Conduct a comprehensive review of literature on Management Information Systems (MIS) related to logbook automation and academic record management.
2. Design a cloud based SIWES logbook system that enables real-time data entry, multi-user collaboration, and secure access for students, supervisors, and institutions.
3. Develop intuitive and user-friendly interfaces that facilitate seamless interaction between students, supervisors, and institutional administrators within the SIWES logbook system.
4. Evaluate the effectiveness and usability of the cloud based SIWES logbook using Task Completion Time (TCT) and user experience.

2. Related Works

The Industrial Training Fund (ITF) launched the Student Industrial Work Experience Scheme (SIWES) in 1973. SIWES is a Federal Government of Nigeria program that involves students, universities, and industry. It is co-ordinated by the National Universities Commission and ITF. (NUC) [10]. Since its introduction, there has been little work done on automating the scheme, especially the logbook component [2]. Most implementations still rely on paper-based logbooks.

In Nigerian tertiary institutions, there is a disconnect between theoretical classroom learning and practical abilities that are needed in the real world in many sectors, including engineering, technology, science, agriculture, medicine, and management [11]. This emphasizes how important it is to give students appropriate hands-on instruction regarding tools, industry-standard work practices, and safety regulations. Students' practical abilities are improved by such hands-on training. [12]. Recognizing that training is crucial for developing an efficient and skilled workforce, which is essential for societal progress, Nigerian tertiary institutions partnered with the Industrial Training Fund to establish the SIWES program. A key component of SIWES is the student logbook, where activities and skills gained are recorded [13].

The current paper-based logbook system has limitations in accessibility, security, and

efficiency. Hence, an effectively designed and implemented electronic logbook system stands to greatly improve the SIWES program. Students can focus more on acquiring practical skills rather than logbook administration. Institutions can better evaluate program outcomes. Industries can more efficiently engage with and mentor students.

2.1 Historical Linkage of Tertiary Institution MIS Adoption to Automated Logbook System

Management Information Systems (MIS) have evolved significantly over the decades, impacting various domains, including academic record management and internship logbooks. From the early adoption of paper-based and local computing solutions to the current shift toward cloud-based services, the demand for efficiency, accessibility, and security has driven continuous innovation [14]. This historical linkage explores the historical development of MIS in logbook automation and academic record management, highlighting the limitations of past systems and the necessity of Logbook-as-a-Service (LaaS).

In the 1980s, academic institutions relied primarily on manual record-keeping for student information management [15]. Logbooks were handwritten or typewritten, stored in physical archives, and subject to damage, loss, and inefficiency. The MIS solutions available during this period were rudimentary and institution-specific, often consisting of mainframe-based database management systems (DBMS) for basic student record storage [16].

The challenges of the 1980s Academic Record-Keeping Systems include the high risk of data loss and degradation due to reliance on paper-based archives [17]. Limited accessibility was also a problem, as records could only be retrieved in physical offices. According to Fisher [17], another issue is the slow processing times for updating or retrieving student information. And there was limited real-time monitoring, making internship logbooks difficult to verify remotely.

During this period, the need for computerized data storage emerged, leading to the development of early MIS applications for

academic institutions. However, these systems were still local and institution-specific, lacking scalability and automation in logbook management.

a) The 1990s: The Rise of Standalone MIS and Localized Digital Logbooks

The 1990s saw a shift towards standalone MIS solutions for academic institutions. Higher institutions began deploying local databases and software applications for student record management, leveraging relational database management systems (RDBMS) like Oracle, FoxPro, and Microsoft Access [18]. Alongside this development is the development of digital logbooks in some institution which are often stored on CD-ROMs or local intranet servers [19]. During this time MIS applications for record-keeping expanded, enabling electronic transcript generation and course registration but Internship logs remained largely manual for most institution, as digital solutions were not yet cloud-based and required on-premises access [20].

The challenges of the 1990s MIS in Logbook Management include limited data accessibility to specific computer terminals as the diffusion of software infrastructure for activities such as this was not popular [21]. The digital logbooks available were local and could not support real-time remote access for supervisors. This era was also frustrated with Limited security measures that left data vulnerable to corruption and unauthorized modifications. During this time, the need for interconnected, real-time academic record management systems became evident, laying the foundation for web-based solutions in the following decade.

c) The 2000s: Web-Based MIS and Early Online Logbooks

With the rise of internet connectivity and cloud technology, the 2000s marked a significant transformation in MIS. Institutions began adopting web-based student portals for academic record management, enabling Online course registration and fee payments, electronic transcript requests and grade tracking and Basic online internship logbooks (used by a few institutions but still not widely implemented) according to Caffrey [22]. Web-based Learning Management Systems (LMS) like Moodle, Blackboard, and Sakai emerged, integrating

student record management with academic processes. Digital logbooks were introduced in some institutions but remained limited in functionality, requiring students to manually upload internship reports rather than real-time logging [23].

According to Ouadoud *et. al.*, (24), Challenges of 2000s MIS in Logbook Management include the Limited cloud integration as Most systems relied on centralized institutional servers, lacking real-time scalability. Disconnected systems when the Digital logbooks is separate from main student portals, making integration difficult. And there was limited mobile accessibility, requiring students to log activities only on designated systems. Despite these advancements, a fully automated and cloud-enabled logbook system was still lacking, creating an opportunity for Logbook-as-a-Service (LaaS).

Akter *et. al.*, [11] classified hematological data using data mining techniques to predict diseases. The analysis was carried out using, namely random forest tree, Naïve Bayes, multilayer perceptron and J48 decision tree on chronic kidney disease dataset. The results obtained shows that multilayer perceptron was found to be more accurate in their studies.

In Oguntunde and Arekete [13], a comparison of Naïve Bayes and k-Nearest Neighbour was made on liver disease and fertility datasets using KNIME. The results showed that k-NN outperformed the Naïve Bayes algorithm in terms of a higher level of interpretability and greater classification accuracy.

The emergence of many new healthcare devices and applications on daily basis, which were however, limited to certain categories of illness had been observed in Ekpo *et. al.*, [14]. The authors stressed the need for more research to evolve techniques for early detection of diseases. In their study, they particularly, explored the significance and available IoT technologies in the e-Health domain.

3. Methodology

To overcome the limitations of the traditional paper-based SIWES logbook system, this study developed a Cloud-Based Logbook-as-a-Service (LaaS) platform that has significantly improved the efficiency, accessibility, and

security of SIWES logbook management. Students can now record their daily activities in real time through an intuitive online dashboard, ensuring that records are consistently updated and instantly retrievable. The platform also enables seamless multi-user collaboration, allowing supervisors and institutional coordinators to monitor student progress and provide timely feedback remotely. This completely eliminates the delays previously associated with manual logbook submissions and reviews.

All logbook entries are automatically encrypted and backed up to secure cloud storage, guaranteeing data integrity and preventing any loss due to damaged or misplaced physical documents. The system features a fully responsive web design, giving students and supervisors effortless access from any internet-enabled device, including mobiles. This flexibility has strengthened engagement between students and their academic or industry supervisors, regardless of location.

The LaaS platform was implemented as a modern web application using HTML, CSS, and JavaScript for a responsive and interactive front-end, PHP for server-side logic and database interactions, and MySQL for efficient structured storage and retrieval of entries. Hosted on the cloud, the system delivers high scalability and global accessibility. By leveraging contemporary cloud computing technologies, the developed LaaS platform has successfully modernised SIWES logbook management, effectively addressing the shortcomings of the traditional system while aligning with current advancements in educational technology.

The Cloud-Based Logbook-as-a-Service (LaaS) platform is designed as a scalable, multi-tenant system hosted on a cloud service provider. This cloud-based approach ensures high availability, security, and seamless accessibility for students, supervisors, and institutional administrators. The system follows a Software-as-a-Service (SaaS) model, where multiple institutions can create and manage their accounts, configure staff and student roles, and monitor SIWES activities remotely.

At the core of the system is a cloud-hosted database connected to the application server,

which manages user authentication, logbook entries, and institutional configurations. The application server, developed using PHP for server-side logic, interacts with a MySQL database deployed in the cloud to handle structured storage and retrieval of logbook entries. This architecture allows students to log in from any internet-enabled device, document their daily internship activities, and save entries securely. The SIWES coordinator at the institution can access these records in real time, ensuring proper monitoring and assessment. Additionally, industry supervisors on the field can log in remotely, review student entries, and provide endorsements, confirming the authenticity of reported activities. The architecture for the LaaS is shown in Figure 1.

The cloud-based deployment of the LaaS platform eliminates the limitations of traditional on-premises logbook systems, such as data loss, accessibility constraints, and lack of real-time updates. The system benefits from automatic backups, encrypted storage, and

global accessibility, ensuring that logbook data remains secure and available anytime. By leveraging cloud computing, the LaaS platform provides a modern, efficient, and scalable solution for SIWES management, enhancing collaboration between students, supervisors, and institutions while improving record-keeping and assessment accuracy.

The system is further modeled using a USE-CASE UML diagram shown in Figure 2. to represent the interactions between users and the system, defining the functionalities required for the LaaS platform. This approach helps in identifying key user roles, such as students, supervisors, and administrators, and outlines the specific actions each role can perform, such as logging daily activities, managing records, and viewing student progress. The USE-CASE UML diagram ensures a clear understanding of system requirements and interactions, facilitating effective design and implementation of the e-logbook system.

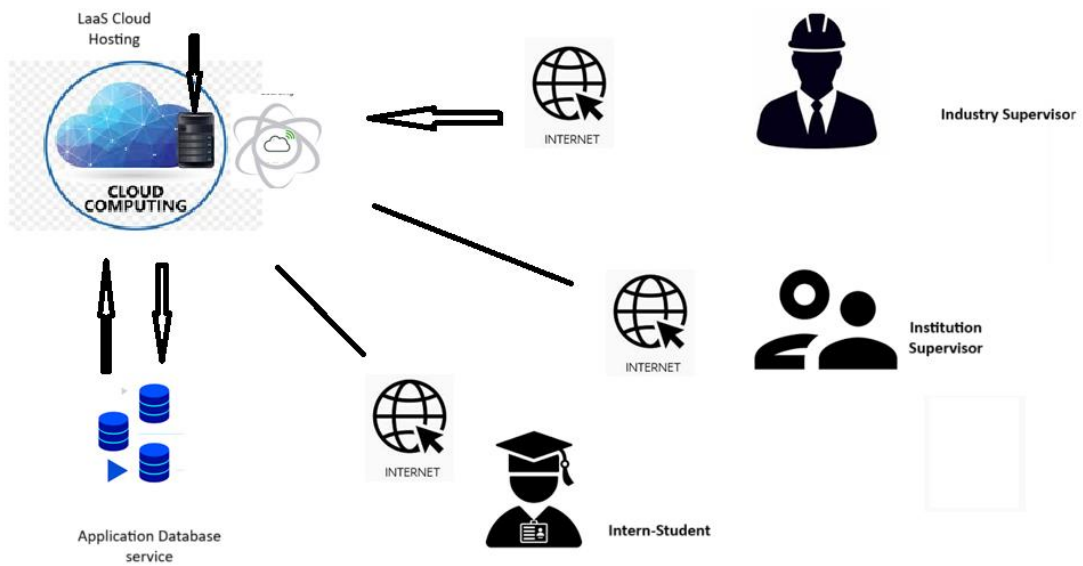


Figure 1: The laaS architecture.

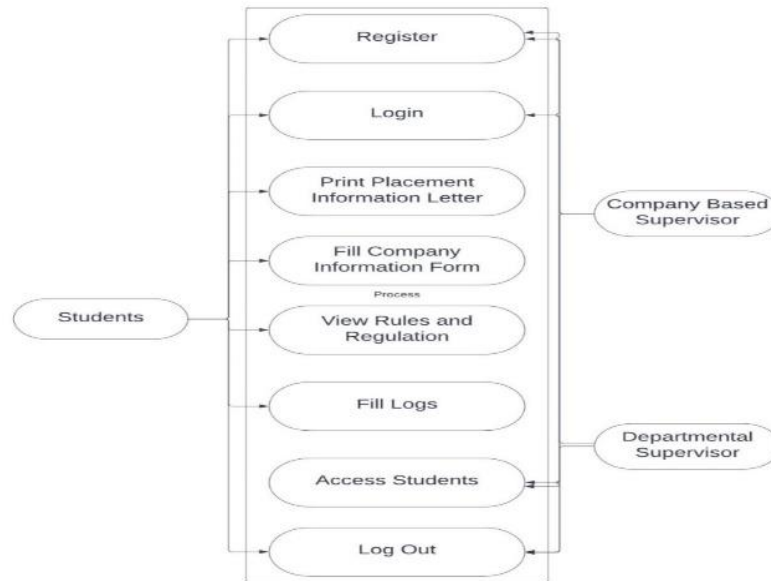


Figure 2: The laaS USE CASE diagram.

4. Results and Discussion

The results of the LaaS platform demonstrate significant advancements in the automation of logbook management processes. Throughout the discussion, emphasis is placed on the comprehensive description of the system's interface, detailing its features and functionalities.

The login module is the entry point for both administrators and students on the LaaS platform. It authenticates users by verifying their credentials and then directs them to their respective module. After logging in, administrators are taken to the home page to access administrative functions. Figure 3. shows the login page which serves as a switchbox to redirect users to their personalized home page, where they can log activities, upload documents, and view feedback. Once a student logs in, they are directed to record their daily activities in the logbook as shown in Figure 4. This module is essential for tracking and managing students' progress throughout the SIWES program, ensuring all work done is accurately logged and easily accessible.

The e-logbook form allows students to detail their daily activities in the online e-Logbook. This page provides an input box to record entries, enabling students to add detailed information about the work they have completed each day as seen in Figure 5. This module ensures accurate and organized entry of

student activities, facilitating easy review and assessment by supervisors.

The industry supervisor's page offers an interface where supervisors can view a list of all students under his supervision. As shown in Figure 6, this module allows supervisors to easily access and monitor the progress, daily logs, and overall performance of each student. This oversight function facilitates effective management and assessment.

Performance Evaluation

Performance evaluation serves as a pivotal component, providing critical insights into the efficiency and effectiveness of various processes of the developed platform. This evaluation process involves systematically assessing performance metrics, identifying strengths, weaknesses, and areas for improvement.

The User Experience Measure

Fifty users were carefully selected to evaluate the performance and functionality of the developed system. Of these, forty users simulated student activities, while ten users simulated supervisors' activities. This evaluation process is a critical step in validating the system's effectiveness, ensuring it meets the intended objectives and addresses user needs. Tables 1(a) and 1(b) provide a detailed analysis of the user experience, focusing on the ease of use and the extent to which user needs were

satisfactorily met. Each task was rated on a scale from 1 to 5, with the following descriptions namely 1: Dissatisfied, 2: Somewhat dissatisfied, 3: Neutral, 4: Satisfied, 5: Highly satisfied

The average rating for each task provides a clear assessment of the user's experience of the various modules.

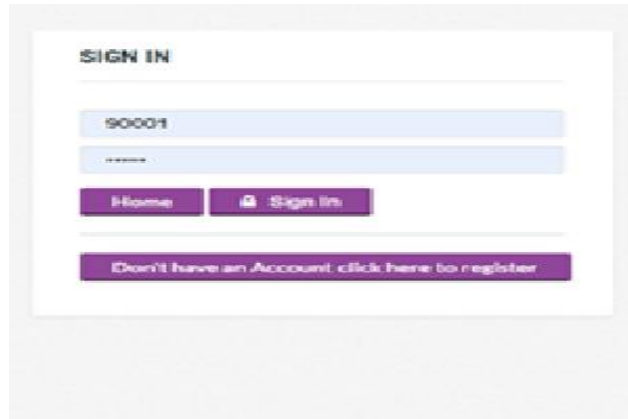


Figure 3: Login page.

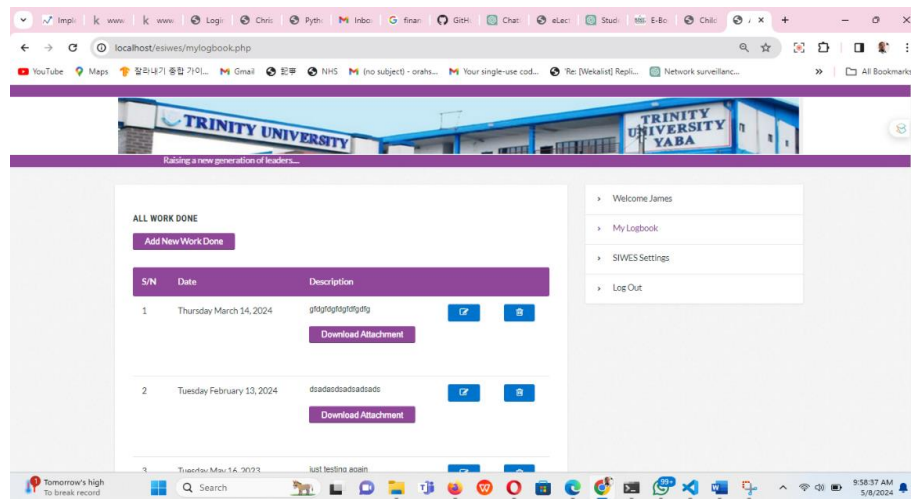


Figure 4: Work done page.

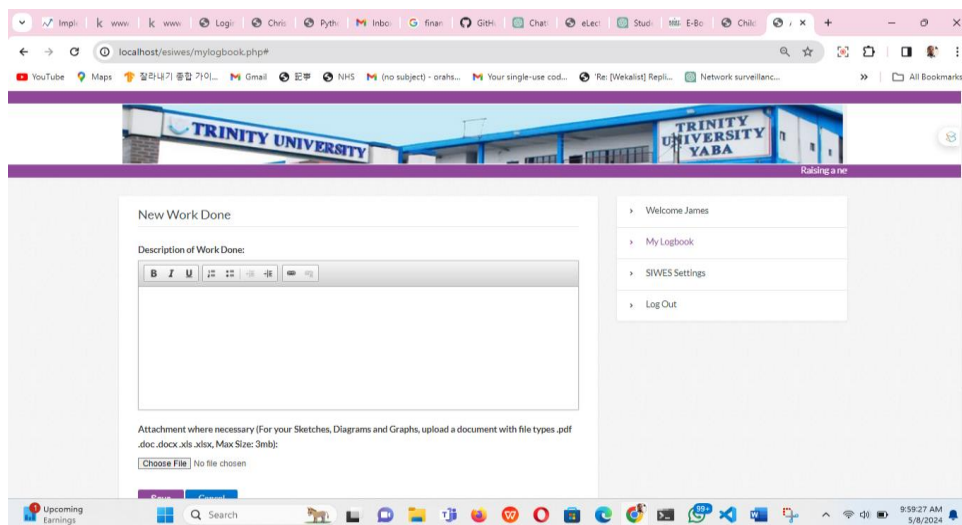


Figure 5: The e-logbook form.

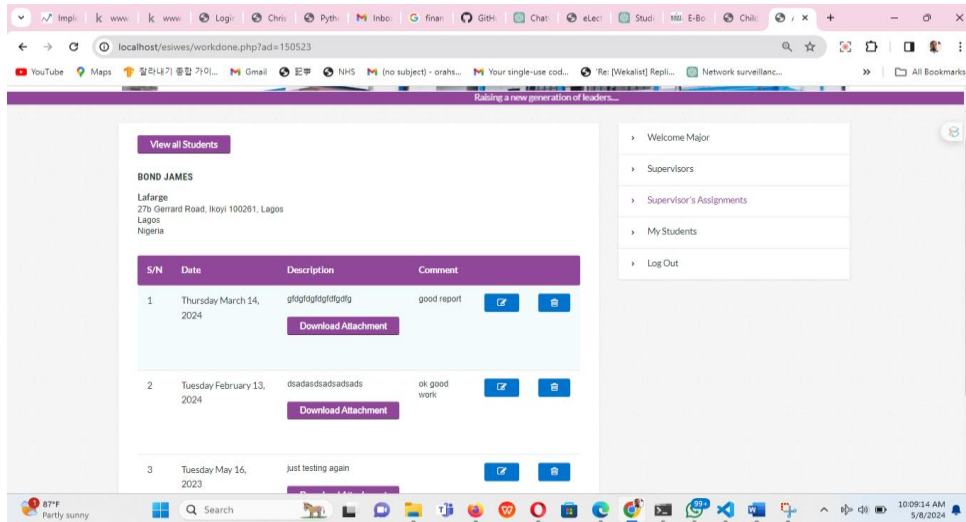


Figure 6: Industry Supervisor's Interface.

Table 1a: The user experience evaluation table (Students)

Task Description	Number of users	Rating 1 (Dissatisfied)	Rating 2 (Somewhat Dissatisfied)	Rating 3 (Neutral)	Rating 4 (Satisfied)	Rating 5 (Highly Satisfied)
Login Process	40	0	0	5	20	15
Data Entry	40	0	0	0	26	14
File Upload	40	0	0	8	22	10

Table 1b: The user experience evaluation table (Supervisor)

Task Description	Number of users	Rating 1 (Dissatisfied)	Rating 2 (Somewhat Dissatisfied)	Rating 3 (Neutral)	Rating 4 (Satisfied)	Rating 5 (Highly Satisfied)
Login Process	10	0	0	0	1	9
Students' data retrieval and evaluation	10	0	0	0	5	5
Comment entry	10	0	0	0	2	8

The evaluation of the developed system was conducted with fifty users, divided into two groups: students (40 users) and supervisors (10 users). Each group was tasked with different activities relevant to their roles, and their experiences were rated on a scale from 1 to 5, where 1 represents "Dissatisfied" and 5 represents "Highly Satisfied." The following insights are derived from the data presented in Tables 1(a) and 1(b).

Table 1(a) showed that No users were dissatisfied or somewhat dissatisfied. 5 users were neutral, 20 were satisfied, and 15 were highly satisfied about

the Login process. This demonstrates that majority of users found the login process satisfactory, indicating that the system's authentication mechanism is efficient and user-friendly. In the data entry module, no users rated the task below neutral. 26 users were satisfied, and 14 were highly satisfied. This suggests that users found it easy to input data into the system. The evaluation of the Upload module showed that majority of users were satisfied with the file upload process, a significant number of users (8) remained neutral, indicating a potential area for minor improvements.

Table 1(b) which evaluates the supervisors' user Experience showed that the login process for supervisors was rated very highly, with no negative or neutral ratings, demonstrating a strong positive reception. Also. The data retrieval and evaluation received uniformly positive feedback, highlighting the effectiveness of the system in retrieving and evaluating student data. The comment entry feature was well-received, with most users being highly satisfied, indicating the system's robustness in handling supervisor feedback. It was noticed that across both user groups, there were no ratings for "Dissatisfied" or "Somewhat Dissatisfied," showcasing that the system met or exceeded user expectations in all evaluated tasks.

Task Completion Time

Table 2 evaluates task completion time across various aspects of the system. Users' completion times for tasks on each interface were assessed. The completion time ratings range from 1 to 5, with the following descriptions namely 1: Longest and unsatisfactory completion time, 2: Longer than optimal completion time, 3: Adequate completion time, 4: Efficient completion time and 5: Shortest and most optimal completion time.

This table offers insights into the distribution of completion time ratings among users and calculates the average completion time rating for each task. This information allows stakeholders to understand how efficiently users perceive tasks to be completed within the system. Tasks

with lower average completion time ratings are generally perceived as being completed more efficiently, while tasks with higher ratings may indicate areas where improvements are needed to streamline processes and enhance user satisfaction.

As represented in Table 2(a), the task completion time evaluation for students indicates high efficiency across various tasks. For the login process, 25 out of 40 students completed the task in a very short time, rating it as 4, and 15 students rated it as 5, indicating the highest efficiency, also, for data entry and file upload tasks, 26 students rated each task as 4, and 14 rated each as 5. This suggests that the system facilitates the swift completion of data entry and file upload tasks, contributing to an efficient workflow for students.

In Table 2(b), the evaluation of supervisors reveals a similarly high level of efficiency in task completion. The login process for supervisors was extremely efficient, with 8 out of 10 supervisors rating it as 5, indicating they completed the task in the shortest time possible, and 2 supervisors rating it as 4. For the task of retrieving and evaluating student data, 7 supervisors rated it as 5, 3 rated it as 4, and only one supervisor rated it as 3. This reflects an overall positive outcome in terms of time taken to complete this task. Additionally, the comment entry task for supervisors received high ratings, with 8 supervisors rating it as 5 and 2 rating it as 4, suggesting that this task was also completed very quickly.

Table 2a: The task completion time evaluation table (Students)

Task Description	Number of users	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5
Login Process	40	0	0	0	25	15
Data Entry	40	0	0	0	26	14
File Upload	40	0	0	0	26	14

Table 2b: The task completion time evaluation table (Supervisor)

Task Description	Number of users	Rating 1 (5min)	Rating 2 (4min)	Rating 3 (3min)	Rating 4 (2min)	Rating 5 (1min)
Login Process	10	0	0	0	2	8
Students' data retrieval and evaluation	10	0	0	1	3	7
Comment entry	10	0	0	0	2	8

Overall, across all tasks for both students and supervisors, there are no ratings of 1 or 2, indicating that none of the tasks took an unreasonably long time to complete. The predominant ratings of 4 and 5 across all tasks demonstrate that the system is highly efficient in enabling users to complete their tasks on time. These results suggest that the computerized logbook system is well-designed to ensure quick task completion, thereby enhancing the operational efficiency of the SIWES program. The system's ability to facilitate rapid task completion underscores its effectiveness in managing SIWES activities and highlights its potential to significantly improve the workflow for both students and supervisors.

The evaluation of overall system performance, considering both task completion time and user experience metrics, indicates positive outcomes. The combination of quick task completion times and high user satisfaction levels reflects optimal system performance. Discrepancies between metrics highlight areas for improvement, but overall, the system demonstrates efficiency and effectiveness. Leveraging insights from both metrics allows stakeholders to develop targeted strategies for further optimization, ensuring continued positive performance and enhanced user experiences.

5. Conclusion

The development of the LaaS platform marks a significant advancement in the management and documentation of the Student Industrial Work Experience Scheme (SIWES). This study showed the limitations of the traditional paper-based system and developed computer-based platform that enhances efficiency, accessibility, and data security. The system uses a registration and login form to ensure that any unregistered user cannot log in to the system. The system though, has a home page that is accessible to the users. From this page, the user can login either as a student or as a supervisor. The admin can also use his secured login ID to log on to the system and make changes to the details in the system such as deleting or adding a user.

6. Recommendations

Further areas recommended for future work include the development of a mobile application version of the SIWES Logbook System that would provide users with more flexibility and convenience, allowing them to access and update their logbooks on the go. Additionally,

conducting a detailed UI/UX analysis to further refine the interface can make the system more intuitive and easier to use, thereby increasing user satisfaction and engagement.

Also, integrating advanced data analytics capabilities to analyse student performance and engagement metrics would provide valuable insights for supervisors and administrators, helping to identify trends, strengths, and areas for improvement. Exploring integration with other educational management systems and tools would enhance data sharing and collaboration, creating a more cohesive educational ecosystem. Developing offline capabilities to allow users to update their logbooks without an internet connection would ensure continuous access and usability, even in areas with limited or no internet connectivity. Implementing additional security features, such as two-factor authentication (2FA) and regular security audits, will protect sensitive user data and ensure the system's integrity.

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