

LIBRO: Library Integrated Barcode Registration Operation System

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Abstract

This study aimed to develop and evaluate the LIBRO: Library Integrated Barcode Registration Operation System as an automated solution to improve the accuracy, efficiency, and record-keeping of library attendance at Philippine School Bahrain. A qualitative developmental research design was employed, incorporating system design, implementation, and evaluation through survey responses from students and library staff. The existing manual system was found to have moderate accuracy ($M=2.60$), low efficiency ($M=2.42$), and low record-keeping performance ($M=2.42$), indicating issues such as errors and difficulty in data retrieval. In contrast, the LIBRO system achieved high ratings in accuracy ($M=3.67$), efficiency ($M=3.78$), and record-keeping ($M=3.83$), indicating faster processing and better data management. Paired t-test results revealed statistically significant differences ($p \leq 0.001$), confirming that LIBROs improved performance. The findings suggest that implementing barcode-based automation enhances library operations, reduces administrative workload, and ensures reliable records. It is recommended that the system be fully adopted and enhanced for broader school applications.

Keywords: barcode system; library attendance; automation; information system; record-keeping

1. Introduction

1.1. Background and Problem of the Study

In today's world, technology and automation are fundamentally reshaping the way people live, learn, and perform everyday tasks. Despite these advancements, many routine activities remain manual, even when automation could improve efficiency, accuracy, and convenience (Raja & Nagasubramani, 2018). One such area is administrative processes in schools, where tasks like recording attendance, tracking student activities, and logging facility usage are often still done on paper.

Varzaru & Bocean (2024) refer to digital solutions as technology-based tools and services designed to enhance processes, improve efficiency, and solve specific problems in various sectors. As these solutions expand globally, schools and educational institutions are increasingly adopting them to improve administrative processes, optimize resource management, and accurately track student activities. However, in many regions including parts of the Middle East and the Philippines, a significant number of schools still rely on paper-based systems, highlighting a persistent gap between technological capability and practical implementation.

Common manual processes at international schools in the Middle East is logging student entry and usage across school facilities. Student attendance collection and management is one of the most time-consuming tasks in any school or education system (Moshayedi et al., 2022), and manual approaches to attendance commonly lead to data-collection errors, time loss, inaccurate records, and other inefficiencies that automated identification

and data-capture technologies can help mitigate (Elaskari et al., 2021). At PSB, the librarian, administrators, and faculty manually record, compile, and verify data, while students frequently forget or incompletely record entries, making the process error-prone and labor-intensive. Handwritten logbooks remain widely used across classrooms, offices, and libraries, particularly in schools with high student populations, highlighting the need for an automated system that can automate the process, improve accuracy, reduce staff workload, and efficiently collect student data for reports, analytics, or monthly summaries.

To address this issue, the study proposes the LIBRO: Library Integrated Barcode Registration Operation System. Students can scan their existing school ID barcodes to record their data, entry and exit, select the purpose of their visit, and have their data automatically organized and categorized. The system is designed to reduce errors, prevent duplicate entries, and automate the monitoring process for both students and librarians. By eliminating manual data entry, it improves accuracy and efficiency while simplifying logging for students and automating record-keeping for staff.

The motivation for choosing this topic comes from firsthand observation of the challenges students face with manual library logging. Entries are often forgotten, incomplete, or duplicated, undermining the accuracy and reliability of library records. The current process is time-consuming, creates inefficiencies, and reduces accountability. By implementing a technological solution, this study aims to improve productivity, ensure accurate data collection, enhance user convenience, and provide a reliable alternative to the existing paper-based system.

Moreover, this project also promotes several United Nations Sustainable Development Goals (SDGs). By automating library attendance and usage tracking, it supports SDG 4 – Quality Education by enabling librarians to monitor student participation, recognize patterns in library usage, and enhance learning outcomes. It advances SDG 12 – Responsible Consumption and Production by reducing reliance on paper records, and promoting sustainable resource use by minimizing waste. Additionally, the system contributes to SDG 16 – Peace, Justice, and Strong Institutions by enhancing accuracy and accountability in school record-keeping. Through these impacts, the project demonstrates how local innovations in school administration can align with global efforts to promote education quality, sustainability, and institutional efficiency.

This study is significant both theoretically and practically. Theoretically, it contributes knowledge on automation, data management, and system efficiency by demonstrating how a simple barcode-based system can automate routine administrative processes in educational settings. Practically, the system offers tangible benefits for schools, including faster and more accurate monitoring of library usage, reduced staff workload, and improved accountability among students. Furthermore, the system provides a scalable model that can be adapted for other school facilities, such as offices, clinics, or restrooms, allowing other institutions to adopt similar solutions to enhance operational efficiency and resource management.

1.2. Review of Related Literature

The effective management of library usage and student attendance has increasingly relied on technological solutions globally. Automated systems such as barcode scanning, radio-frequency identification (RFID), and digital record management tools have been widely implemented to enhance data accuracy, streamline administrative processes, and support decision-making in educational institutions. This review synthesizes both international and regional studies on library automation, barcode systems, attendance tracking, and digital record management, highlighting the relevance and necessity of implementing the proposed LIBRO: Library Integrated Barcode Registration Operation System at Philippine School Bahrain (PSB).

Challenges of Manual Data Recording and the Role of Digital Technology in Education

Globally, institutions and organizations are shifting from manual labor and handwritten, paper-based documentation toward digital and automated systems, as traditional manual processes are inherently slow, inconsistent, and prone to human error. In sectors such as education, manual data recording often results in

incomplete entries, inconsistent formats, duplicated records, and misinterpretations. These issues reduce institutional efficiency, hinder timely decision-making, and weaken the reliability of data used for evaluation and planning. Such persistent challenges elaborate the urgent need for automated systems that enhance accuracy, consistency, and accountability in school record-keeping.

In Middle Eastern and Philippine regions, many educational institutions continue to rely on manual systems for attendance tracking, grading, reporting, and administrative documentation. A study by Perin (2025) localized in Bohol, Philippines, emphasized that integrating digital technologies significantly improves administrative efficiency, especially in attendance monitoring, where manual sign-ins and outdated biometric systems have proven slow, error-prone, and administratively heavy. Despite rapid technological progress in these regions, limited resources, insufficient training, and uneven digital infrastructure continue to slow full adoption of automated systems. As a result, manual data recording frequently leads to delayed reporting, inconsistent records, fatigue-related mistakes, and restricted data accessibility, all of which negatively affect productivity, instructional time, and institutional decision making.

At Philippine School Bahrain (PSB), the limitations of manual processes are clearly evident. Staff and teachers who manually record attendance spend excessive time on paperwork, and repetitive transcription tasks increase the likelihood of documentation errors. Based on an interview with the school librarian, logging student entry and facility usage remains a fully manual process, requiring librarians, administrators, and faculty to record, compile, and verify entries by hand. Students also frequently forget to log their visits or submit incomplete information, making the process labor-intensive, inconsistent, and prone to error. The continued reliance on handwritten logbooks across classrooms, offices, and the library, especially in schools with large populations. This highlights the need for an automated system that improves accuracy, reduces staff workload, and organizes data efficiently for reports, analytics, and monthly summaries.

Efficient monitoring of student activity in school facilities is essential for accurate record-keeping and effective resource management. A study by Raja and Nagasubramani (2018) demonstrates how digital and modern educational technologies significantly streamline administrative tasks and enhance operational efficiency. While technology makes work faster and less time consuming, some processes remain manual, yet the integration of ICT enhances accuracy, consistency, and accountability in institutional recordkeeping, highlighting the need for automated solutions in library logging.

Similarly, the study of Varzaru and Bocean (2024) examines the broader concept of digital transformation and innovation across organizations, and found that adopting digital tools strengthens productivity, improves workflow efficiency, and enhances institutional performance. Their findings indicate that processes such as attendance tracking and resource management become more reliable and easier to monitor when supported by automated technologies, supporting the development of systems like LIBRO.

Furthermore, Muchith (2023) highlights the global impact of digital technologies in education, noting that although successful adoption requires adequate resources and professional development, digital systems greatly enhance monitoring, learning, and institutional efficiency. These collective findings consistently show that automation is an effective and practical solution to the limitations of manual data recording in schools.

Based on these studies, it is clear that the fundamental weaknesses and limitations of manual processes, including inefficiency, inaccuracy, and inconsistency, persist at global, regional, and local levels. In both Middle Eastern and Philippine educational settings, and particularly within institutions like PSB, manual data recording consumes valuable time and compromises the quality of information available for decision-making. These challenges strongly justify the adoption of automated systems designed to improve accuracy, enhance consistency, and elevate overall operational efficiency in school environments.

Technological Solutions for Automated Library and Attendance Systems

Another study by Perin (2025) highlights how the integration of digital technologies in academic administration enhances operational efficiency, particularly in attendance monitoring. Traditional methods such as manual signins and biometric scanners often result in delays, inconsistencies, and a heavy administrative

burden. To address these limitations, Perin evaluated the BISUBilar QR Code Generator and Contact Tracing System, used for student attendance tracking at Bohol Island State University–Bilar Campus. The findings show that QR code–based systems offer a practical, scalable, and highly efficient solution, although enhancements in system stability, crossplatform responsiveness, and data security are essential for long-term institutional adoption. This demonstrates the viability of lightweight, low-cost technologies for improving attendance accuracy in schools.

Moreover, Hendrawan et. al (2025) aimed to evaluate QR Code–based attendance systems for enhancing data accuracy and supporting sustainable school management. Their findings highlight four key advantages: increased efficiency through faster attendance and reduced administrative workload, improved accuracy and reliability through automated digital records that minimize human error; enhanced security using features like randomized, animated, and dynamic QR codes with geofencing and IMEI validation to prevent proxy attendance; and contributions to sustainable school management by integrating attendance with academic and financial systems, promoting transparency and accountability. Overall, it found that QR Code–based systems offer a simple yet strategic technological solution with substantial academic and administrative benefits.

Additionally, Chinedu et. al (2025) highlights that traditional attendance methods are disruptive and prone to record-keeping inconsistencies, which negatively impact instructional time. Their QR code–based system allows students to scan upon entering classrooms, allowing quick and accurate attendance recording. The web-based platform supports lecturers, teachers, and administrators in efficiently managing schedules and records, with real-time database updates for immediate marking and report generation. Students also receive instant attendance notifications, fostering engagement and responsibility. Trials showed improved tracking efficiency and reduced administrative workload, demonstrating that QR code systems are an effective, modern solution for attendance management in educational settings.

Selvan & Vardhini (2025) further examined the impact of electronic attendance systems on student performance and discipline. Their study found that manual attendance methods are susceptible to manipulation, inaccuracies, and unnecessary delays, whereas electronic systems provide real-time, errorfree monitoring that supports more consistent and dependable record-keeping. Despite challenges related to infrastructure and policy alignment, the study concludes that when supported by adequate resources, electronic attendance systems foster improved discipline and contribute to better academic outcomes.

Theoretical Framework Supporting Automated Logging Systems

The development and implementation of LIBRO, an automated library and attendance logging system, is grounded in several interconnected theoretical frameworks that collectively explain its adoption, effectiveness, and potential impact on solving attendance-related challenges.

1. *Technology Acceptance Model (TAM)* was first introduced in 1989 (Davis, 1989), explaining that users are more likely to adopt a system if they perceive it as useful and easy to use. In the context of LIBRO, TAM emphasizes designing the system with user-friendly interfaces, quick barcode scanning, and clear functions to ensure that students, librarians, and faculty recognize its practical benefits in monitoring attendance and library usage. A study by Sarva & Biezā (2023) reinforces this perspective, highlighting that successful integration of digital tools in education depends not only on the technology itself but also on educators' readiness, digital competence, and professional development, supporting TAM's assumptions regarding perceived usefulness and ease of use.
2. *Automation Theory* by Groover (2016) is a conceptual framework that explains how repetitive administrative tasks, such as logging attendance or library entries, are prone to human error and fatigue. Automating these processes through LIBRO reduces staff workload, minimizes mistakes, and allows staff to focus on more meaningful tasks, demonstrating the system's practical value in addressing inefficiencies inherent in manual processes.
3. *Human-Computer Interaction (HCI) framework* by Dix et al. (2017) is a concept about how people interact with digital systems and focuses on making technology easy, efficient, and intuitive to use.

Applying HCI principles to LIBRO ensures that students, teachers, and librarians can navigate the system smoothly, reducing errors and encouraging consistent use, and this is widely recognized in system design for improving usability and user experience.

These frameworks justify the use of LIBRO as a solution to the documented challenges of manual attendance and library logging, aligning technological functionality with user adoption, data accuracy, and operational efficiency. Studies such as those by Perin (2025) and Hendrawan et. al (2025), demonstrate that digital attendance systems improve efficiency, reliability, and administrative workflow, providing practical evidence that supports the theoretical foundations applied in LIBRO. By integrating TAM, Automation Theory, and HCI principles, this system addresses the inefficiencies, inaccuracies, and inconsistencies of manual processes while promoting user acceptance and effective management of school resources.

Available Technologies for Automated Library Attendance Systems

A study by Moshayedi et al. (2022) reviews a wide range of technologies currently used to automate attendance systems in schools, providing a comprehensive comparison of approaches such as biometric systems, facial recognition, RFID-based attendance, QR code scanning, and embedded platform solutions. The study emphasizes that manual attendance is one of the most time-consuming and error-prone administrative tasks, underscoring the need for automated alternatives. Their findings identify key advantages of automated systems including reduced human error, faster data processing, and improved institutional accountability. By comparing these technologies, the study demonstrates that automation enhances accuracy and streamlines attendance tracking, particularly in environments such as school libraries where high student populations require efficient monitoring.

Elaskari et al. (2021) examine the use of barcode systems for tracking student attendance and managing institutional assets, demonstrating that barcode technology serves as a simple, reliable, and cost-effective alternative to traditional manual methods. Many instructors continue to rely on handwritten attendance, which often results in data-collection errors and loss of instructional time. Barcode systems are integrated easily with existing ID cards, eliminate transcription errors, and reduce routine administrative workload. The study shows that barcode-based monitoring significantly improves accuracy while requiring minimal hardware investment, making it a practical option for school libraries and academic institutions seeking efficient yet affordable automation.

Furthermore, a study by Mishra & Verma (2025) elaborates that traditional attendance methods, such as roll calls or paper sign-ins, are inefficient, difficult to manage for large groups, and susceptible to inaccuracies. In contrast, digital solutions like barcode systems offer a streamlined method of uniquely identifying individuals, allowing attendance to be recorded instantly in a centralized database. Compared to biometric systems or mobile applications, barcode-based systems are more cost-effective, easier to deploy, and less intrusive, making them particularly suited for schools aiming to balance efficiency and accessibility. The real-time monitoring and automated reporting features further support timely and accurate data management.

Aldabagh (2025) adds that although traditional pen-and-paper attendance remains widespread, it suffers from time delays, inconsistent record-keeping, and requires extra steps for generating reports. To overcome these limitations, various automated attendance systems have been developed, generally classified into biometric and non-biometric approaches. Biometric systems verify students through physiological characteristics, ensuring accurate identification and controlled access. Non-biometric systems, such as barcode and QR code-based solutions, provide practical and efficient alternatives without the need for sophisticated hardware. A review of over forty empirical studies underscores the benefits of these automated approaches and presents a new classification framework that reinforces the growing shift toward digital attendance tools.

Similarly, Al Sheikh et. al (2019) emphasizes the effectiveness of barcode-based systems in addressing inefficiencies of traditional attendance methods. Their system integrates Unified Modeling Language (UML) diagrams for structured design, ensuring clarity and functional organization. User testing involving 20 students

indicated high usability, reliability, and practicality, while automated tracking and reporting capabilities enabled lecturers to manage attendance records in real time. These findings prove that barcode-based solutions offer precise, user-friendly, and cost-efficient alternatives suitable for educational environments.

Best Practices in Library Automation and Attendance Management

There are several studies that provide evidence on the practical, accurate, and effective nature of barcode-based attendance systems in educational settings. Mishra & Verma (2025) emphasize that successful implementation of such systems requires careful attention to workflow integration, usability, and sustainability. User-friendly interfaces, rapid scanning capabilities, and centralized data management not only reduce administrative workload but also enhance accuracy and facilitate timely reporting and analysis. Moreover, minimizing paper usage promotes environmental sustainability, making barcode systems a scalable, efficient, and sustainable solution for modern attendance management. These proven benefits justify the adoption of similar technology at Philippine School Bahrain (PSB).

A study by Chanda (2019) demonstrates that integrating barcode technology in school libraries significantly accelerates resource management processes. The system reduces manual errors in book issuance and returns, decreases staff workload, and enables real-time tracking of library usage. Feedback from students and staff indicated high usability and satisfaction, reinforcing compliance and efficiency. Such findings support the integration of barcode-based library automation within the LIBRO system.

Moreover, Shakir (2023) further highlights the importance of accurate attendance recording for monitoring student participation and assessing performance. Traditional pen-and-paper methods are time-consuming and prone to errors, particularly in large student populations. By employing a mobile application where students scan teacher-provided codes, attendance is automated, eliminating manual work and minimizing mistakes. This approach exemplifies a practical, reliable, and user-friendly method for efficient attendance management.

Vinod et. al (2021) examine the combination of RFID and fingerprint biometrics as an effective approach to attendance management. Their system streamlines record-keeping, reduces errors, enables rapid verification, and minimizes human involvement, enhancing both time and labor efficiency. With mobile-friendly interfaces, multiple access levels, and robust security features, the system was successfully tested on 100 students, demonstrating accuracy, reliability, and ease of use. These results provide a model for organized and efficient attendance management applicable to academic institutions.

Finally, Sundawa et. al (2023) highlights the limitations of manual attendance, noting its environmental impact, vulnerability to fraud, and challenges in maintaining health protocols post-pandemic. Their prototype system, in which students scan unique barcodes on ID cards through a mobile application, ensures touchless, accurate, and secure attendance recording. Data are automatically logged in a centralized Google Spreadsheet, enabling real-time monitoring and reporting while reducing administrative workload and supporting environmentally sustainable practices.

STEM Relevance

The implementation of LIBRO is particularly relevant for STEM students, as it reinforces precision, computational thinking, data management, and technological literacy. It requires skills essential for laboratory work, projectbased learning, and problem-solving. By combining practical automation with educational objectives, the system addresses administrative inefficiencies while simultaneously supporting the development of critical STEM competencies, demonstrating its value both operationally and academically.

Synthesis

The reviewed literature consistently shows that manual attendance and library record-keeping are inefficient, error-prone, and time-consuming, while digital solutions such as barcode, QR code, and RFID systems enhance accuracy, efficiency, and administrative workflow. Theoretical frameworks like the Technology Acceptance Model (TAM), Automation Theory, and HumanComputer Interaction (HCI) emphasize that successful adoption

depends on usability, user acceptance, and proper system integration. Global and regional studies support the benefits of automation, but context-specific solutions for schools like Philippine School Bahrain remain limited, highlighting the need for tailored, user-friendly systems such as LIBRO.

1.3. Research Gap

Despite the global adoption of digital attendance and library management systems, many schools in the Middle East and the Philippines still rely on manual, paper-based processes. While previous studies show how barcode, QR code, and RFID systems can improve accuracy, efficiency, and workflow, most focus on large universities with advanced technological infrastructure. Moreover, these solutions are rarely implemented in everyday school settings, creating an action-knowledge conflict between research and real-world application. A geographical gap also exists, as schools such as Philippine School Bahrain (PSB), with high student populations and manual logging, are an underrepresented population facing persistent inefficiencies. This highlights the need for a localized, integrated system that automates library and attendance tracking while ensuring usability, accuracy, and operational efficiency for both staff and students.

1.4. Scope and Delimitation

This study focuses on the development and implementation of the LIBRO: Library Integrated Barcode Registration Operation System at Philippine School Bahrain (PSB). The scope includes automating the logging of student attendance and library usage through barcode scanning of existing school IDs, tracking the purpose and duration of visits, and generating reports for librarians and school staff. The system will be initially tested with students and library staff and is intended for future expansion to include all high school students and potentially elementary students. Evaluation will focus on the system's usability, accuracy, efficiency, and operational impact compared to the existing manual logging system. However, due to ongoing conflict in the Middle East, the school has shifted to online learning, limiting the study to simulations, prototype testing, and online feedback instead of on-site implementation.

The delimitation of the study excludes monitoring of other school facilities outside the library, such as classrooms, offices, clinics, or laboratories, though future plans may expand the system to these areas. Additionally, the system does not extend to library functions already managed by existing systems, such as book borrowing and returns. It does not include monitoring student behavior, conduct, or compliance beyond logging entry, exit, and purpose of visit. The study will focus solely on barcode-based automation and will not assess alternative identification technologies such as RFID or QR codes. Furthermore, the project is limited to the specific context of PSB and its student population and may not be directly generalizable to schools with different populations, infrastructure, or administrative policies.

1.5. Conceptual Framework

This study is anchored on the Input–Process–Output (IPO) model, which illustrates the systematic flow of components and procedures involved in the development of the LIBRO: Library Integrated Barcode Registration Operation System. The framework explains how specific inputs are transformed through defined processes to produce measurable outputs that address the identified problems in manual library attendance and record-keeping. These processes involve storing student data, integrating hardware components, and connecting the system to a cloud server for data management and testing. As a result, the LIBRO system produces an automated and reliable library barcode registration system that enhances efficiency, accuracy, and record-keeping while demonstrating how inputs and processes interact to achieve successful system development.

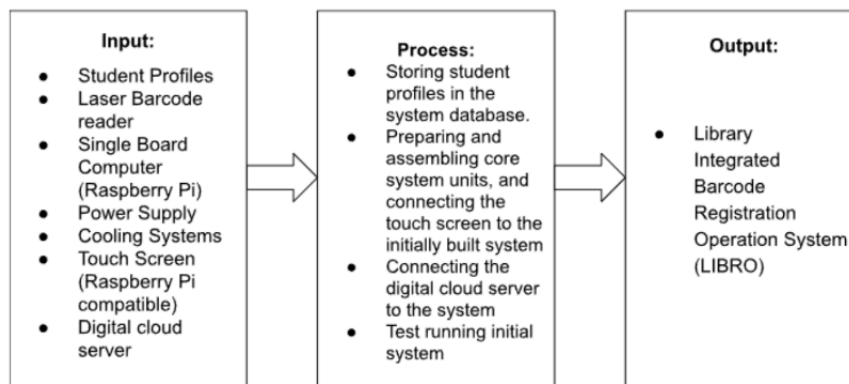


Figure 1. Conceptual framework for LIBRO: Library Integrated Barcode Registration Operation System

1.6. Research Objectives

The objective of this capstone is to develop the LIBRO: Library Integrated Barcode Registration Operation System that is able to document current manual library attendance practices, identify challenges in the manual logging system, and evaluate the system's potential for improving accuracy, efficiency, and record-keeping, with a targeted implementation date in April 2026.

1.7. Statement of the Problem

Library operations play a vital role in supporting academic learning and access to information at Philippine School Bahrain. However, the library still relies on handwritten attendance monitoring, which can lead to inefficiencies, inaccuracies, and fragmented record-keeping. These challenges affect the accuracy of records, the efficiency of workflows, and the overall experience of both library users and staff. With the growing integration of technology in educational institutions, there is a need to explore systems that streamline library processes while ensuring accurate and reliable data collection.

Anchored on a conceptual framework integrating barcode technology, user-system interaction, and digital record management, this study examines the LIBRO: Library Integrated Barcode Registration Operation System as a tool to automate library registration, entry logging, and operational monitoring. The framework assumes that the use of a barcode-based system may influence library efficiency, user experience, and data accuracy, which in turn shape perceptions of effectiveness and reliability in library operations. This study aims to describe these indicators and explore the relationships among them within the library setting.

Specifically, this study seeks to answer the following questions:

1. How is the current manual library attendance logging at Philippine School Bahrain described in terms of:
 - 1.1 Accuracy;
 - 1.2 Efficiency;
 - 1.3 Record-keeping?
2. How is the LIBRO-implemented library attendance logging described in terms of:
 - 2.1 Accuracy;
 - 2.2 Efficiency;
 - 2.3 Record-keeping?
3. Is there a significant difference between the manual and LIBRO implemented logging system described in terms of:

- 3.1 Accuracy;
- 3.2 Efficiency;
- 3.3 Record-keeping?

2. Methodology

This chapter presents the research methodology employed to examine the impact of LIBRO: Library Integrated Barcode Registration Operation System on the manual library logging process at Philippine School Bahrain. It describes the research design, materials, system blueprint, procedures, and participants used to evaluate the system's efficiency.

2.1. Research Design

This study adopts a quantitative, quasi-experimental research design to assess the impact of implementing LIBRO: Library Integrated Barcode Registration Operation System on library operations at Philippine School Bahrain. It utilizes a descriptive-comparative approach to examine differences in accuracy, efficiency, and record-keeping effectiveness between the manual library logging system (pre-implementation) and the LIBRO automated system (post-implementation).

A quantitative research design allows for the systematic collection and analysis of numerical data, enabling objective measurement of key variables and statistical evaluation of the system's effectiveness. The quasi-experimental design introduces LIBRO as an intervention, comparing pre- and postimplementation outcomes to determine its impact on library operations. The descriptive-comparative approach focuses on identifying measurable differences between the two systems.

2.2. Materials and Equipment

The materials and equipment to be used in this study are essential for the operation of the LIBRO: Library Integrated Barcode Registration Operation System. These resources will support the transition from manual to automated library logging and will contribute to improvements in accuracy and efficiency. The following is the compiled list of materials and equipment to be used in the study:

Table 1: List of Materials for Library Attendance System

Material	Quantity	Brand/Type	Purpose
Flat Flexible Cable (FFC)	2 pcs	Generic	Connector for Display
Micro SD Card	1 pc	Sandisk	Operating System and Storage
DC Brushless Fan	1 pc	SHCHV (Small cooling fan)	To attach and cool off the Raspberry Pi

Table 2: Equipment for LIBRO

Equipment	Model	Purpose
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Raspberry Pi 4 8GB	Raspberry Pi 4 Model B	Main system unit running the OS, barcode scanner, and system code
5-inch DSI Touch Display	iPistBit 5-inch DSI Display	View and interact with Raspberry Pi system
Barcode Scanner	EVAWGIB	To scan and encode student number to the attendance system
Small Screwdriver	Generic	To assemble screws for mounting and hardware installation.
S12-Flip Vivobook Laptop	ASUS	To code, download required softwares, and provide power.
3A Output USB-C Cable	Go-Des	To provide power for the Raspberry Pi 4.
Visual Studio Code	Microsoft	To code python in windows.
Thonny IDE	Python 3 (Raspberry Pi OS)	To code python in Raspberry Pi OS.

2.3. Research Procedures

This study will employ a systematic research and development approach to address the identified problem through the creation of an automated digital library login system. The process will begin with problem identification and analysis, followed by the conceptualization of a technological solution tailored to the department's needs. Relevant materials and system requirements were gathered to support development. The proposed system, called the Library Integrated Barcode Registration Operation System (LIBRO), is designed and developed through programming and hardware implementation. Prior to deployment, the system underwent an approval process to ensure functionality, security, and compliance with institutional standards.

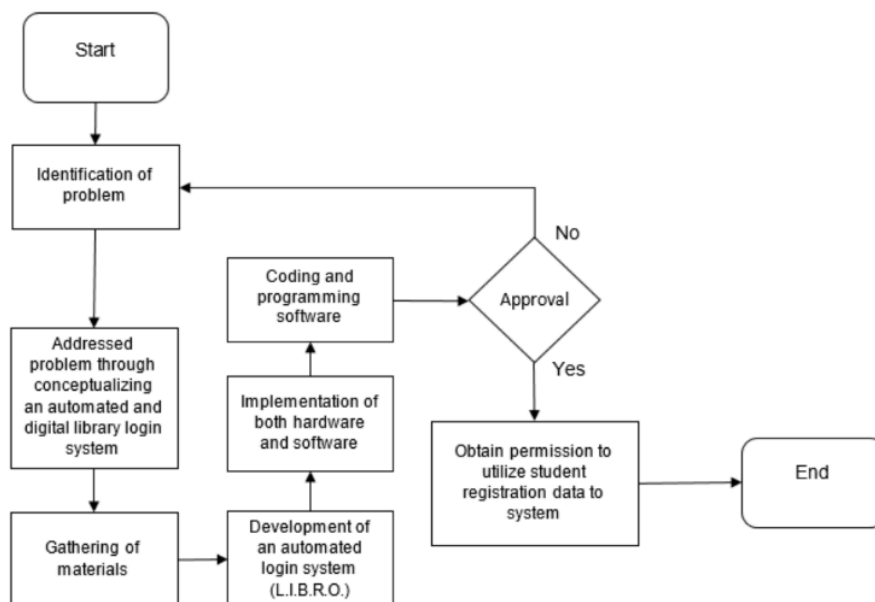


Figure 2. Research Procedures for the Implementation of LIBRO

Figure 2 illustrates the step-by-step procedures followed in developing and implementing the system.

Upon approval, student and staff registration data were integrated, leading to system deployment and completion of the study. The results demonstrate that LIBRO improves efficiency, accessibility, and reliability of library services at Philippine School Bahrain and provides a foundation for future system enhancements.

2.4. Project Blueprint

The following blueprint serves as the structural backbone of LIBRO. By mapping the core functions and processes, from the system's internal features to its physical housing design, it establishes a cohesive framework that supports both conceptual integrity and operational efficiency. This blueprint not only outlines how each component interacts within the system, but also ensures that design decisions remain aligned with the overall objectives. In doing so, it bridges the gap between abstract planning and practical implementation, translating high level goals into a clear, tangible flow of activities that guide the project from initial development through to final delivery.

Figure 3 further illustrates the process blueprint of the Library Integrated Barcode Registration Operation System, LIBRO, presenting a detailed sequence of operations. It highlights each stage of user interaction, beginning with barcode scanning, followed by data validation, and progressing through user authentication. The process concludes with purpose selection, ensuring that each transaction is accurately recorded and aligned with the system's intended functionality. Together, these steps provide a streamlined and reliable workflow that enhances both user experience and overall system performance.

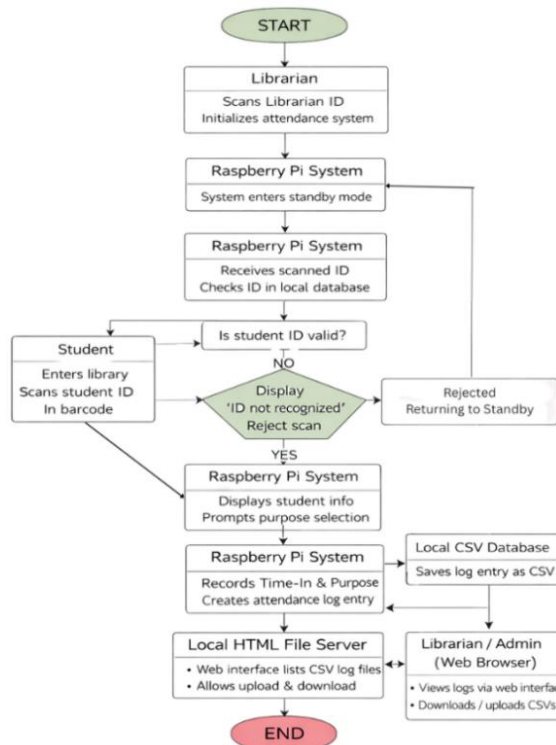


Figure 3. Project Blueprint for the Process of LIBRO

Figure 4 presents the project model blueprint of LIBRO, showing the planned external overview of the system, including its main components. The planned overview was originally intended to be developed using 3D materials and other design elements to create a casing that is easy to use and understand, especially for younger students, while still fitting the library environment.

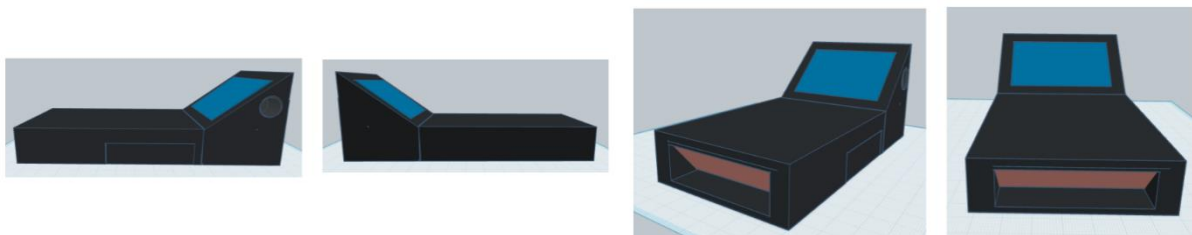


Figure 4. Project Model Blueprint for LIBRO

The design was kept simple and was meant to be placed in the same area as the manual attendance system, making it accessible for both teachers and students. However, due to current circumstances in the Middle East, we were unable to obtain and complete the required materials. Nonetheless, the system itself remains fully functional and operates as intended.

2.5. Data Collection Instrument and Procedures

The study will employ a survey to collect data relevant to its objectives, aiming to provide insights into the current manual library logging system and assess its effectiveness for both students and library staff.

A survey questionnaire utilizing a 4-point Likert scale will be administered to gather data on the efficiency, accuracy, and record-keeping practices of both the manual library logging system and the LIBRO automated system, and the results will be compared.

The instrument will be constructed by the researchers and validated by an expert to ensure that the data collected are relevant and aligned with the objectives of the study. A table summarizing the data to be gathered from the questionnaire will be presented below:

Table 3: Verbal Interpretation of Gathered Data

Data	Accuracy	Efficiency	Record-Keeping
4	High Accuracy	High Efficiency	High Record-Keeping
3	Moderate Accuracy	Moderate Efficiency	Moderate Record-Keeping
2	Low Accuracy	Low Efficiency	Low Record-Keeping
1	Very Low Accuracy	Very Low Efficiency	Very Low Record-Keeping

2.6. Research Locale and Participants

The study be conducted at the Philippine School Bahrain, which serves as the primary location where the implementation of LIBRO will take place. The respondents of this study include students, staff, and the librarian, who actively use the school library system. They were selected as participants because they have direct experience with library operations and can provide relevant insights regarding the effectiveness and usability of LIBRO.

A purposive sampling method was employed to ensure that only participants with relevant knowledge and experience were included. This approach was chosen because it allows the researchers to target individuals who can provide detailed and meaningful information for the study. The sample consists of 4 students, 4 school administrators and staff, and 1 librarian, who met the specific inclusion criteria outlined in Table 4. Any potential participant who did not give their consent was automatically excluded from the study, even if they met the necessary experience requirements.

Table 4: Inclusion and Exclusion Criteria for Participants

Inclusion	Exclusion
Specific Experiences: Visits the library at least once a week	Visits the library less than a week
Availability for Data Collection: Able to answer surveys or interviews	Did not provide consent in taking part in the research

2.7. Treatment of Data

To process the data gathered from the questionnaires administered to the users of the LIBRO system, appropriate statistical tools will be employed based on the nature of the data and the specific research questions. For the first and second research questions, descriptive statistical tools such as frequency counts, percentages, and weighted mean will be used to determine how users, including library staff, perceive the manual library attendance logging system and the automated LIBRO system in terms of accuracy, efficiency, and record-keeping.

For the third research question, a paired samples t-test will be utilized to compare the levels of accuracy, efficiency, and record-keeping before and after the implementation of LIBRO. This statistical test is appropriate as the same group of respondents will evaluate both systems, allowing the study to determine whether a significant improvement occurred after the adoption of the automated system.

To interpret the weighted mean scores using a 4-point Likert scale, the following table was utilized to translate numerical values into descriptive categories reflecting users' perceptions of the impact of the LIBRO automated system on library attendance logging:

Table 5: Interpretation of Weighted Mean for the 4-Point Likert Scale

Interval Scale	Accuracy	Efficiency	Record-Keeping
3.50 - 4.00	High Accuracy	High Efficiency	High Record-Keeping
2.50 - 3.49	Moderate Accuracy	Moderate Efficiency	Moderate Record-Keeping
1.50 - 2.49	Low Accuracy	Low Efficiency	Low Record-Keeping
1.00-1.49	Very Low Accuracy	Very Low Efficiency	Very Low Record-Keeping

2.8. Ethical Considerations

This study will adhere to ethical standards throughout the research process. Since the implementation of LIBRO involves the collection of data from students and librarians, key ethical concerns include data privacy, confidentiality, and informed participation. To address these concerns, all data gathered for this study including personally identifiable information such as student IDs, names, and sections, will be securely stored and accessible only to the researchers and their advisers. Personal identifiers will not be disclosed, and responses will be used solely for academic purposes, ensuring participants' privacy. Before participating in the study, all individuals were required to provide informed consent. This process ensured that they willingly and actively agreed to take part in the study and share honest feedback about their experiences. By securing proper authorization and handling data responsibly, this study aims to minimize ethical risks and maintain research integrity.

3. Results and Discussion

This chapter presents and analyzes the overall accuracy, efficiency, and record-keeping performance of both the manual library logging system and the LIBRO automated system. The analysis is based on survey responses and focuses on evaluating improvements in library logging compared to the manual system. Findings are presented in alignment with the study's objectives and research questions.

3.1. Manual Library Attendance Logging at Philippine School Bahrain

Manual Library Attendance Logging in Terms of Accuracy

Accuracy is essential in any library attendance system, as it ensures student entries and exits are properly recorded. Reliable records prevent inconsistencies, maintain accountability, and provide librarians and staff with trustworthy data. Evaluating the manual system's accuracy establishes a baseline for comparison with the LIBRO-implemented system. Table 9 presents the survey results on the accuracy of the manual library attendance logging system, showing mean scores and verbal interpretations based on the perceptions of students and library staff.

Table 6 presents the survey results on the accuracy of the manual library attendance logging system, showing mean scores and verbal interpretations based on the perceptions of students and library staff.

Table 6: Perception of Accuracy of Manual Library Logging System

Items	Mean	Int.
1. Manual attendance records are accurate.	2.67	Moderate Accuracy
2. Errors in manual attendance recording rarely occur.	2.56	Moderate Accuracy
3. Student information in manual attendance records is recorded clearly and correctly.	2.78	Moderate Accuracy
4. The manual logbook prevents duplication of records.	2.56	Moderate Accuracy
Overall Perception of Accuracy of the Manual Library Login System	2.6	Moderate Accuracy
Interpretation Table: 3.50 – 4.00 High Accuracy; 2.50 – 3.49 Moderate Accuracy; 1.50 – 2.49 Low Accuracy; 1.00 – 1.49 Very Low Accuracy		

The highest-rated items, “Student information in manual attendance records is recorded clearly and correctly” (2.78) and “Manual attendance records are accurate” (2.67), indicates that student details are generally recorded properly, despite minor errors. The lowest-rated items, “Errors in manual attendance recording rarely occur” and “The manual logbook prevents duplication of records” (both 2.56), suggest that occasional errors and record duplication are observed.

The composite mean of 2.60 confirms that the manual library attendance system is moderately accurate. This indicates that the current system functions adequately but remains prone to common errors, highlighting opportunities for improvement through automation.

These results align with previous studies showing that manual attendance systems are prone to errors and inconsistencies. Perin (2025) reported that manual attendance in Bohol, Philippines, was slow and errorprone, while Hendrawan et al. (2025) found that QR code-based systems significantly reduce human error. Similarly, Selvan and Vardhini (2025) concluded that traditional manual methods are vulnerable to inaccuracies and delays, supporting the adoption of automated solutions.

This means that while the manual system performs its intended function, it exhibits limitations in preventing errors and record duplication. This underscores the need for an automated system like LIBRO to enhance accuracy, reliability, and overall efficiency in library attendance logging.

Manual Library Attendance Logging in Terms of Efficiency

Efficiency refers to how quickly and effectively a library attendance system allows students and staff to log entries and exits without causing delays or disruptions. Evaluating efficiency is crucial to understanding whether the manual system supports smooth library operations and how much time and effort it requires.

Table 7 presents the survey results on the perceived efficiency of the manual library attendance logging system, showing mean scores and verbal interpretations based on respondents.

Table 7. Perception of Efficiency of Manual Library Logging System

Items	Mean	Int.
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1. Logging attendance manually is quick and time-efficient.	1.89	Low Efficiency
2. Students can log their attendance manually without delays.	2.33	Low Efficiency
3. Manual attendance logging does not disrupt library operations.	2.78	Moderate Efficiency
4. The time required to record attendance manually is reasonable.	2.67	Moderate Efficiency
Overall Perception of Efficiency of the Manual Library Login System	2.42	Low Efficiency

Interpretation Table: 3.50 – 4.00 High Efficiency; 2.50 – 3.49 Moderate Efficiency; 1.50 – 2.49 Low Efficiency; 1.00 – 1.49 Very Low Efficiency

The highest-rated item, “Manual attendance logging does not disrupt library operations”, with a mean of 2.78, shows that despite delays, the system still maintains moderate operational continuity. The lowest-rated item, “Logging attendance manually is quick and time-efficient” with a mean of 1.89, which can be interpreted that the process is generally slow and time-consuming.

The overall composite mean of 2.42 indicates low efficiency, suggesting that the manual system is slow, often causes delays, and requires considerable time and effort from both students and staff.

These findings are supported by related studies. Perin (2025) reported that manual attendance methods in Philippine educational settings are laborious and administratively heavy. Similarly, Chinedu et al. (2025) found that web-based QR code attendance systems significantly improved speed and reduced data processing time compared to manual systems. Mishra & Verma (2025) also emphasized the time delays and inefficiencies associated with traditional attendance recording, contrasting them with the quicker, automated capture that barcode or QR systems provide.

In conclusion, while the manual system allows continuous operations, it is generally inefficient and time-consuming, reinforcing the need for an automated solution like to enhance procedural speed and minimize delays.

Manual Library Attendance Logging in Terms of Record-Keeping

Record-keeping refers to how organized, complete, and accessible library attendance records are. Effective record-keeping ensures data is properly stored, easy to retrieve, and reliable for reporting, decision-making, and accountability. Evaluating the manual system’s record-keeping highlights its strengths and limitations for comparison with the LIBRO system.

Table 8 presents the survey results on the perceived record-keeping performance of the manual library attendance logging system, including mean scores and verbal interpretations based on student and staff responses.

The highest-rated item, “Manual attendance records are properly stored and maintained” (2.78), suggests that respondents generally find that records are kept in an organized and secure manner. The lowest-rated item, “Retrieving manual attendance data is easy” (2.11), indicates that accessing information is difficult and time-consuming. Items regarding organization (2.33) and completeness/reliability (2.44) show that while some aspects of record-keeping are adequate, inconsistencies and gaps still exist.

The composite mean of 2.42 indicates low record-keeping, highlighting challenges in organization, accessibility, and reliability.

Table 8: Perception of Record-Keeping of Manual Library Logging System

Items	Mean	Int.
1. Manual attendance records are well organized.	2.33	Low Record-Keeping
2. Retrieving manual attendance data is easy.	2.11	Low Record-Keeping
3. Manual attendance records are complete and reliable.	2.44	Low Record-Keeping
4. Manual attendance records are properly stored and maintained.	2.78	Moderate Record-Keeping
Overall Perception of Record-Keeping of the Manual Library Login System	2.42	Low Record-Keeping

Interpretation Table: 3.50 – 4.00 High Record-Keeping; 2.50 – 3.49 Moderate Record-Keeping; 1.50 – 2.49 Low Record-Keeping; 1.00 – 1.49 Very Low Record-Keeping

These results align with studies by Perin (2025), Chinedu et al. (2025), and Hendrawan et al. (2025), which show that manual systems are prone to inefficiencies and errors, while automated solutions improve accuracy, accessibility, and overall efficiency.

In summary, the manual system performs basic record-keeping but has clear weaknesses, emphasizing the need for an automated system like LIBRO to enhance reliability and efficiency.

3.2. Alpha Test of LIBRO-Implemented Library Attendance Logging System

Alpha Test of LIBRO in Terms of Accuracy

Automated systems are designed to enhance reliability and minimize human error. The LIBRO system integrates technology to accurately record student attendance, ensure data consistency, and prevent duplication, supporting informed decision-making and efficient library operations. Assessing the accuracy of LIBRO highlights the effectiveness of automation in addressing the limitations regarding accuracy of traditional manual logging.

Table 9 presents survey results on the perceived accuracy of the LIBRO system, including mean scores and verbal interpretations from both students and library staff.

Table 9: Perception of Accuracy of LIBRO Automated System

Items	Mean	Int.
1. The LIBRO system records attendance accurately.	3.78	High Accuracy
2. Errors in recording attendance using LIBRO rarely occur.	3.44	Moderate Accuracy
3. Student information in the LIBRO system is recorded clearly and correctly.	3.67	High Accuracy
4. The LIBRO system prevents duplication of attendance records.	3.78	High Accuracy
Overall Perception of Accuracy on LIBRO System	3.67	High Accuracy

Interpretation Table: 3.50 – 4.00 High Accuracy; 2.50 – 3.49 Moderate Accuracy; 1.50 – 2.49 Low Accuracy; 1.00 – 1.49 Very Low Accuracy

The highest-rated items, “The LIBRO system records attendance accurately” and “The LIBRO system prevents duplication of attendance records” (3.78), demonstrates that the system maintains reliable and unique records. “Student information in the LIBRO system is recorded clearly and correctly” (3.67) confirms that student details are consistent, correct, and clear. The lowest-rated item, “Errors in recording attendance using LIBRO rarely occur” (3.44), indicates that occasional errors can happen, but they are significantly reduced compared to manual logging.

With a composite mean of 3.67, the LIBRO system exhibits high accuracy. This reflects its capacity to deliver dependable and precise attendance tracking, illustrating the advantages of automation in library management.

The results align with research emphasizing technological solutions for attendance. Hendrawan et al. (2025) reported that QR code-based systems minimize human error and ensure data integrity, while Chinedu et al. (2025) found that web-based automated attendance systems improve reliability and reduce record duplication. These studies underscore the role of automation in enhancing accuracy and efficiency in educational settings.

The LIBRO system demonstrates a marked improvement in accuracy over traditional methods, providing consistent, clear, and duplication-free attendance records. This highlights the value of automation for enhancing reliability and supporting efficient library operations

Alpha Test of LIBRO in Terms of Efficiency

Efficiency in automated systems extends beyond speed, reflecting how well the system optimizes workflow, reduces cognitive and administrative effort, and creates a smoother experience for both students and library staff. The LIBRO system aimed to simplify attendance logging, streamline operations, and improve both productivity and user satisfaction.

Table 10 presents survey results on the perceived efficiency of LIBRO, including mean scores and verbal interpretations from respondents.

Table 10: Perception of Efficiency of LIBRO Automated System

Items	Mean	Int.
1. Using LIBRO to log attendance is quick and time efficient.	3.78	High Efficiency
2. Students can register their attendance using LIBRO without delays.	3.78	High Efficiency
3. Using the LIBRO system does not disrupt library operations.	3.67	High Efficiency
4. The time required to record attendance using LIBRO is reasonable.	3.89	High Efficiency
Overall Perception of Efficiency on LIBRO System	3.78	High Efficiency

Interpretation Table: 3.50 – 4.00 High Efficiency; 2.50 – 3.49 Moderate Efficiency; 1.50 – 2.49 Low Efficiency; 1.00 – 1.49 Very Low Efficiency

All items scored highly, reflecting strong efficiency and workflow optimization. The highest-rated item, “The time required to record attendance using LIBRO is reasonable” (3.89), demonstrates that the system minimizes effort and streamlines operations. “Using LIBRO to log attendance is quick and time-efficient” and “Students can register their attendance using LIBRO without delays” (both 3.78) indicate that students can quickly and easily log attendance without frustration. “Using the LIBRO system does not disrupt library operations” (3.67) highlights that library processes continue smoothly, showing that LIBRO integrates seamlessly into daily operations.

The composite mean of 3.78 indicates high efficiency, showing that LIBRO not only reduces time and effort but also significantly improves the overall workflow and user experience compared to manual logging methods.

These results align with studies emphasizing workflow optimization in automated systems. Hendrawan et al. (2025) highlighted that QR code–based systems enhance operational smoothness and reduce staff workload. Similarly, Chinedu et al. (2025) found that web-based attendance platforms improve efficiency by reducing manual tasks, streamlining procedures, and enhancing user satisfaction.

LIBRO enhances efficiency by simplifying processes, reducing effort, and improving workflow. Beyond speed, it provides a smoother, more user-friendly attendance logging experience for students and library staff, illustrating the advantages of integrating automated solutions in educational environments

Alpha Test of LIBRO in Terms of Record-Keeping

Effective record-keeping is a critical factor of a reliable library attendance system, ensuring that data is organized, easily retrievable, complete, and properly maintained. Unlike manual systems, automated solutions like LIBRO aim to minimize errors, streamline data management, and provide staff and students with trustworthy attendance records.

Table 11 shows survey results on respondents’ perception of recordkeeping using the LIBRO system.

Table 11: Perception of Record-Keeping of LIBRO Automated System

Items	Mean	Int.
1. Attendance records in the LIBRO system are well-organized.	3.78	High Record-Keeping
2. Retrieving attendance data from the LIBRO system is easy	3.89	High Record-Keeping
3. Attendance records in the LIBRO system are complete and reliable.	3.78	High Record-Keeping
4. Records in the LIBRO system are properly stored and maintained.	3.89	High Record-Keeping

Overall Perception of Record-Keeping on LIBRO System

3.83 High Record-Keeping

Interpretation Table: 3.50 – 4.00 High Record-Keeping; 2.50 – 3.49 Moderate Record-Keeping; 1.50 – 2.49 Low Record-Keeping; 1.00 – 1.49 Very Low Record-Keeping

All items scored highly, and the highest-rated items, “Retrieving attendance data from the LIBRO system is easy” and “Records in the LIBRO system are properly stored and maintained” (both 3.89), suggest that the system greatly simplifies data access and storage reliability. The lowest-rated items, “Attendance records are well-organized” and “Records are complete and reliable” still received a high mean (both 3.78), indicating that while the system is highly effective, there may be minor areas for refinement.

The composite mean of 3.83 reflects an overall high perception of record-keeping, showing that LIBRO significantly enhances organization, accessibility, and reliability compared to the manual system.

These results align with previous research emphasizing the benefits of automated attendance systems in record management. Chinedu et al. (2025) reported that web-based QR code systems facilitate faster and more accurate retrieval of attendance data, while Mishra & Verma (2025) highlighted that automated systems improve completeness, storage, and reliability over manual methods.

Therefore, the LIBRO system demonstrates excellent record-keeping capabilities, offering well-organized, easily accessible, and reliable attendance data, effectively addressing limitations observed in traditional manual systems.

3.3. Comparison Between Manual and LIBRO-Implemented Library Attendance Logging Systems

Accuracy, efficiency, and record-keeping are essential indicators of a library attendance system’s performance. Comparing these factors between the manual and LIBRO-implemented systems provides insight into how automation enhances reliability, speed, and organization. This analysis is crucial for determining which system ensures accurate student attendance tracking, supports smooth library operations, and demonstrates whether LIBRO offers a significant improvement over the manual process.

Table 12 presents the paired t-test results comparing the manual and LIBRO systems across accuracy, efficiency, and record-keeping.

Table 12: Paired t-Test Comparing Manual and LIBRO Accuracy, Efficiency, and Record-Keeping

Items	p-value	Interpretation
1. Accuracy	0.001	Significant Difference
2. Efficiency	< .001	Significant Difference
3. Record-Keeping	0.001	Significant Difference

*Significant at 0.05 or less

The t-test results show that all three factors have statistically significant differences at the 0.05 level. Accuracy yielded $t(8)=4.97$, $p=0.001$, efficiency $t(8)=6.52$, $p<0.001$, and record-keeping $t(8)=4.91$, $p=0.001$.

These results indicate that the LIBRO system significantly outperforms the manual system in all evaluated aspects. The largest difference is observed in efficiency ($t = 6.52$), suggesting that automation greatly reduces time and effort compared to the manual process. Accuracy and record-keeping also show notable improvements, highlighting that LIBRO not only records attendance more reliably but also organizes and maintains data more effectively.

Table 13 shows the descriptive statistics, including mean, standard deviation, standard error, and coefficient of variation for each factor in both systems.

Table 13: Descriptive Statistics Comparing Manual and LIBRO Attendance Systems

Items	System	Mean	Interpretation
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Accuracy	Manual	2.6	Moderate Accuracy
	LIBRO	3.67	High Accuracy
Efficiency	Manual	2.42	Low Efficiency
	LIBRO	3.78	High Efficiency
Record-Keeping	Manual	2.42	Low Record-Keeping
	LIBRO	3.83	High Record-Keeping

Interpretation Table: 3.50 – 4.00 High: Accuracy, Efficiency, Record-Keeping; 2.50 – 3.49 Moderate: Accuracy, Efficiency, Record-Keeping; 1.50 – 2.49 Low Interpretation: Accuracy, Efficiency, Record-Keeping; 1.00 – 1.49 Very Low Interpretation: Accuracy, Efficiency, Record-Keeping

Table 13 shows the descriptive statistics for accuracy, efficiency, and record-keeping in both systems. LIBRO has higher means across all factors, efficiency (3.78), record-keeping (3.83–3.89), and accuracy (3.67), indicating faster, more reliable, and better-organized attendance logging. The manual system shows lower means, highlighting delays, errors, and difficulties in data management.

The improvements observed in the LIBRO system are supported by previous research. Hendrawan et al. (2025) and Chinedu et al. (2025) reported that automated attendance systems significantly increase speed and reduce administrative workload, reflecting the efficiency gains seen in Table 16.

Likewise, Perin (2025) and Selvan & Vardhini (2025) noted that manual attendance systems are prone to errors and inconsistencies, which aligns with the improvements in accuracy and record-keeping when using LIBRO. These studies collectively support the conclusion that automation enhances reliability, organization, and operational efficiency in attendance logging.

Overall, the paired t-test confirms that adopting the LIBRO system leads to significant improvements in accuracy, efficiency, and record-keeping, supporting the transition from a manual to an automated library attendance system. The results demonstrate that automation enhances reliability, reduces administrative effort, and strengthens the organization of records, providing clear evidence for the value of implementing LIBRO in school libraries.

3.4. Summary of Findings

1. The manual library attendance system at Philippine School Bahrain demonstrated moderate accuracy, low efficiency, and low recordkeeping performance. While student details were generally recorded correctly, occasional errors and duplication of records were observed, reflecting limitations in reliability. Efficiency was affected by timeconsuming logging processes and delays in student registration, and record-keeping was marked by difficulties in retrieving data and inconsistencies in organization and completeness. These results highlight that the manual system, though functional, is prone to errors, inefficiencies, and administrative challenges, aligning with previous studies that indicate traditional manual methods are slow and errorprone (Perin, 2025; Hendrawan et al., 2025; Selvan & Vardhini, 2025). Overall, the manual system fulfills its basic function but exhibits clear areas for improvement.
2. The LIBRO automated system significantly scored high performance across all evaluated factors. Accuracy was high, with records clearly and correctly maintained, and errors were rare. Efficiency improved notably, as students could log attendance quickly without delays, and library operations continued smoothly without disruption. Record-keeping was well-organized, complete, and easily retrievable, ensuring reliable and secure data storage. These results are consistent with prior studies that show automated systems enhance reliability, reduce administrative effort, and streamline workflow (Hendrawan et al., 2025; Chinedu et al., 2025). This shows that LIBRO provides a highly efficient, accurate, and well-organized attendance logging system, effectively addressing the limitations of manual methods.

3. The paired t-test comparing manual and LIBRO-implemented systems confirmed statistically significant improvements in all factors: accuracy ($t(8)=4.97$, $p=0.001$), efficiency ($t(8)=6.52$, $p<0.001$), and record-keeping ($t(8)=4.91$, $p=0.001$). These results indicate that LIBRO significantly outperforms the manual system, with the largest improvement observed in efficiency, highlighting the benefits of automation in reducing time and effort. Accuracy and record-keeping also showed enhancements, demonstrating the system's ability to maintain reliable, organized, and duplication-free records. The findings support the research hypothesis that automation significantly enhances library attendance management, providing clear evidence that transitioning to LIBRO improves operational effectiveness, reliability, and data management in school libraries.

4. Conclusions and Recommendations

4.1. Conclusions

Based on the findings of the study, the manual library attendance system at Philippine School Bahrain is only moderately effective, showing clear limitations in accuracy, efficiency, and record-keeping. It still produces errors and duplicate entries, requires time-consuming processes that cause delays and demand considerable effort from both students and staff, and maintains records that are often disorganized, incomplete, and difficult to retrieve. In contrast, the LIBRO automated system demonstrates significantly higher performance across all evaluated areas, with statistical results confirming improvements in accuracy, efficiency, and record management, enabling faster attendance logging, reducing workload, minimizing errors and duplication, and ensuring wellorganized and easily accessible data, with the most notable enhancement seen in efficiency, ultimately proving that LIBRO is the better system for modernizing and improving library attendance management.

4.2. Recommendations

Based on the findings and conclusions, the researchers would like to recommend the following:

1. The Philippine School Bahrain library may consider fully implementing the LIBRO automated attendance system as the main method for logging student attendance. Doing so will address the limitations of the manual system by ensuring more accurate, efficient, and reliable recordkeeping while reducing errors and duplication of entries.
2. The school administration may consider integrating LIBRO with other school systems, such as offices and clinics, to improve workflow and reporting. Additional enhancements, such as optimizing the cloud server, adding new features and housing, and refining system interfaces, can further improve usability and provide a more comprehensive, user-friendly experience for both students and staff.
3. Future research may gather qualitative data through open-ended interviews or surveys to assess system usability, user satisfaction, and staff perspectives. This information can help refine LIBRO further, provide insights into its impact on library operations, and guide continuous improvement of the system.

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