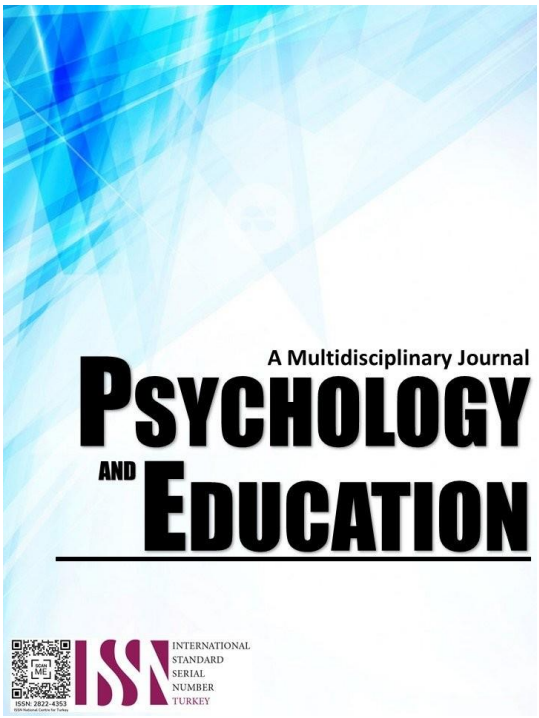
EFFICIENT STUDENT MONITORING AND DATA TRACKING SYSTEM



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Research Article

Efficient Student Monitoring and Data Tracking System

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Abstract

Rising requisites demanding correct and real-time information, data monitoring and tracking systems have become essential to educational institutions, particularly because attendance monitoring is vital for academic performance, safety, and communication. In contrast, traditional methods of monitoring students have been treated with concern, elevating the urgency of developing an innovative solution that would integrate real-time tracking and data management. The study designed, developed, and evaluated an online student monitoring and data tracking system for Isulan National High School. Using Agile, the system was developed over seven sprints, applying features like data security, attendance monitoring, and reporting. It was evaluated by teachers, parents, and students through perception, and overall, the respondents rated it as very functional, usable, and effective. The results showed an average score of 4.72 ± 0.43, and 95% of respondents believed that the system is effective in improving student monitoring and tracking. There was no significant difference in the assessments between each of the groups; $F(3,76) = 0.29$, $p = 0.83$.

Keywords: *student monitoring, data tracking system*

Introduction

In today's technology-driven world, data monitoring and tracking systems have become critical tools in enhancing efficiency across various sectors, including education. These systems streamline processes, safeguard privacy, and ensure accountability while addressing the growing demands for accurate and real-time information.

Moreover, the rise of technology in the new millennium has situated data and monitoring and tracking system a salient discourse (Solove, 2016). It suggests efficiency of work process where privacy and demand of information collection in a legal undertaking which underscores work accomplishment. According to Lalzai (2023) an effective management of efficiency in data monitoring will contribute strategies to improve complete efficiency of the plan, allocation, supervision and control in the industry. Besides, it established a timely value in the new era of technology and work processes nowadays.

On the other hand, in educational institutions, attendance monitoring serves as a vital component of student management, as it directly impacts academic performance, safety, and communication between schools and families. In the current educational landscape, effective student monitoring and data tracking are essential to ensure personalized learning, optimize teaching methods, and foster student success (White, 2025).

In addition, monitoring students is a comprehensive approach designed to create a more responsive and adaptive learning environment that addresses individual student needs while ensuring overall academic achievement. It provides educators with the ability to track attendance, grades, behavior, and other key performance indicators in real-time. By offering valuable insights, it helps identify learning patterns, strengths, and areas for improvement, allowing for timely intervention and support (Kolosky, 2023).

Globally, the importance of efficient attendance monitoring systems has been well-documented. For instance, Nawale (2024) explored a real-time attendance monitoring system in India, integrating hardware and software to improve accuracy and transparency. This innovative approach utilized facial recognition and fingerprint identification to mitigate issues like false attendance reporting. Meanwhile, Arif (2018) highlighted the significance of attendance monitoring in Malaysia's educational institutions, noting that traditional methods often resulted in inefficiencies, such as time delays and inaccuracies. These studies demonstrate the global shift towards digital solutions in addressing attendance-related challenges.

However, according to the Philippine National Statistics Office (2022) reported that 18.6% of children aged 5-24 were not attending classes due to various reasons. Gebhardt (2023) claimed that monitoring measures the unique needs of learners and evaluate these needs based on the data gathered from monitoring and tracking and thus channel learners' academic support.

Cervantes (2019) observed a pressing concerns that learners are strictly monitored however, using the traditional method of paper and pen tracking and students particularly those in the Technical-Vocational-Livelihood (TVL) strands, were skipping classes without their parents' knowledge. This gap in communication and oversight has significant implications for student safety, accountability, and academic performance. Addressing this issue requires an innovative solution that integrates real-time tracking with data management to bridge the gap between the school and parents.

Thus, the development of an efficient student monitoring and data tracking system was materialized. The system aims to modernize attendance monitoring by introducing a streamlined, technology-driven approach that ensures accuracy, transparency, and accessibility. Beyond addressing absenteeism, this initiative seeks to foster collaboration among stakeholders, including teachers, students, and

parents, to create a supportive educational environment.

Research Objectives

Generally, this study aimed to designed, developed, and evaluate an innovative student real-time monitoring and data tracking system including the attendance and schedule of the students to enhance the educational management and decision-making processes at Isulan National High School. Specifically, this study sought to answer:

1. To assess the level of student monitoring and data tracking system performance in terms of:
    1.1. functionality;
    1.2. reliability; and
    1.3. efficiency?
2. Evaluate the user acceptability of the system among stakeholders in terms of:
    2.1. security and privacy;
    2.2. accuracy; and
    2.3. transparency?
3. Determine the significant difference in the user acceptability of efficient student monitoring and data tracking systems as rated by:
    3.1. teachers;
    3.2. parents; and
    3.3. students

Methodology

This section presents the details of the design, determination of the software and hardware compositions, selection of methodology and creation of diagrams, scheme of the database, correlation of salient variables and processes contain in the study to secure relevant data.

Table 1. *Software Specifications*

Requirement	*Minimum Specification*	*Recommended Specification*	*Description*
Operating System	Windows 7 / macOS 10.12	Windows 10 / macOS 10.15	The operating system on which the software ran.
Processor	Intel Core i3 or equivalent	Intel Core i5 or better	The central processing unit of the system
RAM	4 GB	8 GB or more	The memory available for the system to use
Storage	256 GB	512 GB or more	The storage capacity of the system
Development Environment	Visual Studio Code	Visual Studio Code	The software used for writing, testing, and debugging code
Programming Language	JavaScript	Latest stable version	The language used for coding the software
Scripting Language	Node.js / PHP	Latest stable version	The language used for server-side scripting and dynamic content generation
HTML/CSS	HTML5 / CSS3	Latest stable version	The markup and style languages used for designing and laying out web pages
Database	MySQL 8.0	MySQL latest Version	The software used for storing and managing data

Table 1 shows software requirements to specify the functional and non-functional requirements of the system, including what the software will do and how it will perform. This information helps in designing, developing, and testing the software to ensure it meets the needs of the users and stakeholders. The software requirements also help in defining the scope of the project, ensuring that all necessary features are included, and that the development effort is focused in the right areas.

Table 2. *Hardware Specifications*

Requirement	*Minimum Specification*	*Recommended Specification*	*Description*
Computer Type	Desktop / Laptop	Desktop / Laptop	The type of computer required for running the system
Monitor	14-inch LCD	21-inch or larger LCD	The display device for the system
Keyboard	Standard USB Keyboard	Standard USB Keyboard with numeric keypad	The input device for typing text
Mouse	Standard USB Mouse	Standard USB Mouse with scroll wheel	The input device for navigating the user interface
Printer	Inkjet / Laser	Networked Laser Printer	The output device for printing documents

Table 2 shows hardware requirements to specify the physical components and devices that are necessary to run the software, as well as the minimum and recommended specifications for those components. This information helps in determining the system's capabilities and limitations, as well as ensuring that the hardware is compatible with the software. The hardware requirements also help in selecting

the appropriate hardware components and ensuring that they are available and properly configured for the software to run effectively.

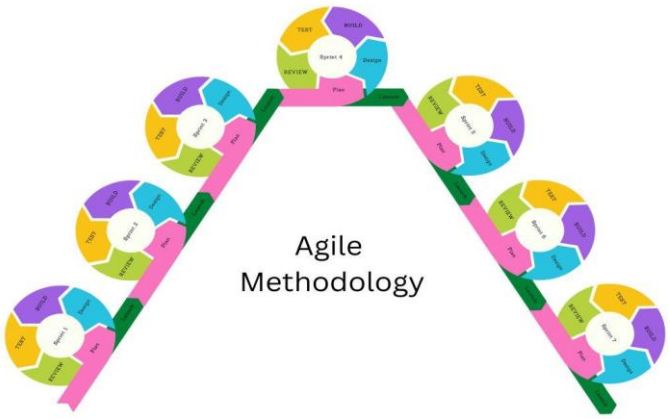

Figure 1. *Agile Methodology*

This approach aim to provide multiple chances to evaluate the project's progress throughout its development cycle by using Agile methods.

This approach involve breaking down tasks into smaller parts and required less planning. Iterations were short periods of time, usually lasting 10 to 30 days, during which the entire team perform planning, requirements analysis, design, coding, unit testing, and acceptance testing. At the end of each iteration, stakeholders will present with a working prototype, which reduce overall risk and allow for a more flexible response to changes. Although will complete iteration may not be ready for release, the goal is to have it available after each iteration. It might have taken multiple iterations to fully develop a system and enhancement.

Groups of related tasks are as follows:

Sprint 1: Manage Data Security for Teacher, Student and Parent

During the planning phase, the researcher will determine the data security requirements for teacher and student information, identify potential security threats and determine the best ways to mitigate them and create a timeline for the sprint, including milestones and deadlines.

During the designing phase, the researcher will create detail designs for the data security features, including user authentication, access controls, and data encryption. Consider user experience and usability when designing the data security features to ensure that they are easy to use and understand. Collaborate with the teacher, student and parent to gather feedback and refine the designs.

During the building phase, the researcher will develop the data security features according to the designs. Implement user authentication and access controls to ensure that confidential information is only accessible to authorize users. Implement data encryption to protect sensitive information from unauthorize access and conduct regular code reviews and testing to identify and fix any bugs or issues.

During the testing phase, the researcher will test the data security features to ensure that they met the requirements and function correctly and verify that the data security features were compatible with other systems and applications. In addition, it ensures that the data security features will handle high volumes of data and transactions.

During the review phase, the researcher reviews the data security features to identify any issues or improvements, then gathers feedback from teachers, student, and parent to understand their experiences and perceptions of the data security features. Evaluated the results of the testing phase and made any necessary improvements or adjustments.

During the launch phase, the researcher will launch the data security features, making them available to users. It will provide training and support for end users to help them understand how to use the data security features and monitor the performance and usage of the data security features to identify any areas for improvement.

Sprint 2: Attendance details for students:

During the planning phase, the researcher will define the scope of the sprint, including the objectives and goals of the schedule details for parents. It will determine the necessary resources, including tools, application programming interface, plugins, and establish a timeline for the sprint, including deadlines for each phase.

During the designing phase, the researcher will create a detailed design for the student schedule, including the user interface, the attendance monitoring process, and the data structure. It will determine the necessary data inputs, including student information and student schedule details. And creates a design document that includes the design details and requirements for the feature.

During the building phase, the researcher will develop the student monitoring and data tracking, including the ability for parents to be updated with the attendance through short message service (SMS). This will ensure that the attendance integrate with existing systems and data sources and implement quality assurance processes to ensure that the software meets the specify requirements.

During the testing phase, the researcher will conduct thorough testing of the student monitoring attendance, including functional and performance testing. It will address any bugs or issues that were found during testing and made necessary changes. Then, verify that the attendance monitoring met the specifications and requirements.

During the review phase, the researcher will review the results of the testing phase and evaluate the success of the sprint. Identify any areas for improvement and make necessary changes. It will obtain feedback from parents to ensure that the attendance monitoring met their needs and expectations.

During the launch phase, the researcher will launch the attendance monitoring, making it available to parents. Provide training and support for parents. Monitor the system for any issues or concerns and address them promptly.

Sprint 3: Scheduled details for student and teacher:

During the planning phase, the researcher will define the scope of the sprint, including the objectives and goals of the scheduling details feature for students. It will determine the necessary resources, including tools, technology, and personnel. Establish a timeline for the sprint, including deadlines for each phase.

During the designing phase, the researcher will create a detailed design for the student scheduling feature, including user flows and interface design. Determine the necessary data sources and the structure of the schedule. Created a design document that included the design details and requirements for the student scheduling feature.

During the building phase, the researcher will develop the student scheduling feature, including user authentication, viewing of schedule, and confirmation processes. Then, implement quality assurance processes to ensure that the software meets the specify requirements.

During the testing phase, the researcher conducted thorough testing of the student scheduling feature, including functional and performance testing. Then, it addressed any bugs or issues that will be found during testing and made necessary changes. After verifying that the student scheduling feature met the specifications and requirements.

During the review phase, the researcher will review the results of the testing phase and evaluate the success of the sprint. Then, identify any areas for improvement and make necessary changes. Obtain feedback from laboratory specialists to ensure that the appointment scheduling feature met their needs and expectations.

During the launch phase, the researcher will launch the student scheduling feature, making it available to students. Provide training and support for laboratory specialists. Monitor the system for any issues or concerns and address them promptly.

Sprint 4: Management of Parameter with QR code ID:

During the planning phase, the researcher defines the scope of the sprint, including the objectives and goals of the parameter management and QR code sticker generation feature. They determine the necessary resources, including tools, technology, and personnel, and establish a timeline for the sprint, including deadlines for each phase.

During the designing phase, the researcher will create a detailed design for parameter management and QR code sticker generation feature, including user flows and interface design. They determined the necessary data sources and the structure of the parameters and created a design document that included the design details and requirements for the feature.

During the building phase, the researcher will develop the parameter management and QR code sticker generation feature, including the ability to add, edit, and delete parameters. They will implement the QR code generation and labeling process, ensuring that the QR code accurately represented the parameter, and implemented quality assurance processes to ensure that the software met the specified requirements.

During the testing phase, the researcher conducted thorough testing of the parameter management and QR code sticker generation feature, including functional and performance testing. They address any bugs or issues that were found during testing and made necessary changes.

During the review phase, the researcher reviews the results of the testing phase and evaluates the success of the sprint. They identify any areas for improvement and make necessary changes. They obtain feedback from the user to ensure that the feature met their needs and expectations.

During the launch phase, the researcher launches the parameter management and QR code sticker generation feature, making it available to users. They provide training and support for users and monitor the system for any issues or concerns and address them promptly.

Sprint 5: Teacher encodes student i:

During the planning phase, the researcher defines the scope of the sprint, including the objectives and goals of the monitoring and tracking encoding feature. Determine the necessary resources, including tools, technology, and personnel. Established a timeline for the sprint, including deadlines for each phase.

During the designing phase, the researcher will create a detailed design for the water quality analysis encoding features, including user flows and interface design. Determine the necessary data sources and the structure of the student's schedule and attendance. Then, create a design document that includes the design details and requirements for the feature.

During the building phase, the researcher will develop the monitoring and tracking encoding features, including the ability to add, edit, and delete the data. Ensure that the data enter was accurate and consistent. Implement actual data processes to ensure that the software meets the specify requirements.

During the testing phase, the researcher will conduct thorough testing of the student's schedule and attendance encoding features, including functional and performance testing. Address any bugs or issues that were found during testing and made necessary changes. Verify that the feature met the specifications and requirements.

During the review phase, the researcher review the results of the testing phase and evaluate the success of the sprint. Identify any areas for improvement and make necessary changes. Obtain feedback from users to ensure that the feature meets their needs and expectations.

During the launch phase, the researcher launches the student's schedule and attendance encoding feature, making it available to users. Provide training and support for users. Monitor the system for any issues or concerns and address them promptly.

Sprint 6: Data Tracking of Short Message Service (SMS)to parents:

During the planning phase, the researcher defines the scope of the sprint, including the objectives and goals of the transaction status tracking feature. They determine the necessary resources, including tools, technology, and personnel, and establish a timeline for the sprint, including deadlines for each phase.

During the designing phase, the researcher will create a detailed design for the transaction status tracking feature, including user flows and interface design. They determine the necessary data sources and the structure of the transaction status data and created a design document that includes the design details and requirements for the feature.

During the building phase, the researcher developed the transaction status tracking feature, including the ability for parents to receive a message. They ensure that the transaction status information was accurate and up to date and implement quality assurance processes to ensure that the software meets the specified requirements.

During the testing phase, the researcher will conduct thorough testing student monitoring attendance and data tracking features, including functional and performance testing. They addressed any bugs or issues that is found during testing and made necessary changes. They verify that the feature met the specifications and requirements.

During the review phase, the researcher reviews the results of the testing phase and evaluates the success of the sprint. They identify any areas for improvement and make necessary changes. They obtain feedback from users to ensure that the features meet their needs and expectations.

During the launch phase, the researcher will launch the transaction status tracking feature, making it available to clients. They provided training and support for users and monitored the system for any issues or concerns, addressing them promptly.

Sprint 7: Generation of reports:

During the planning phase, the researcher will define the scope of the sprint, including the objectives and goals of the report generation feature. They determine the necessary resources, including tools, technology, and personnel, and establish a timeline for the sprint, including deadlines for each phase.

During the designing phase, the researcher will create a detailed design for the report generation feature, including the types of reports that would be generated, their format, and how they would be distributed. They determine the necessary data sources and the structure of the data to be included in the reports and create a design document that includes the design details and requirements for the feature.

During the building phase, the researcher will develop the report generation feature, including the ability to generate various types of reports. They ensure that the reports include accurate and up to date data, and implement quality assurance processes to ensure that the software met the specify requirements.

During the testing phase, the researcher will conduct thorough testing of the report generation feature, including functional and performance testing. They addressed any bugs or issues that were found during testing and made necessary changes and verify that the feature met the specifications and requirements.

During the review phase, the researcher reviews the results of the testing phase and evaluates the success of the sprint. They identify any areas for improvement and made necessary changes and obtain feedback from users to ensure that the feature met their needs and expectations.

During the launch phase, the researcher will launch the report generation feature, making it available to stakeholders. They provide training and support for users and monitor the system for any issues or concerns and address them promptly.

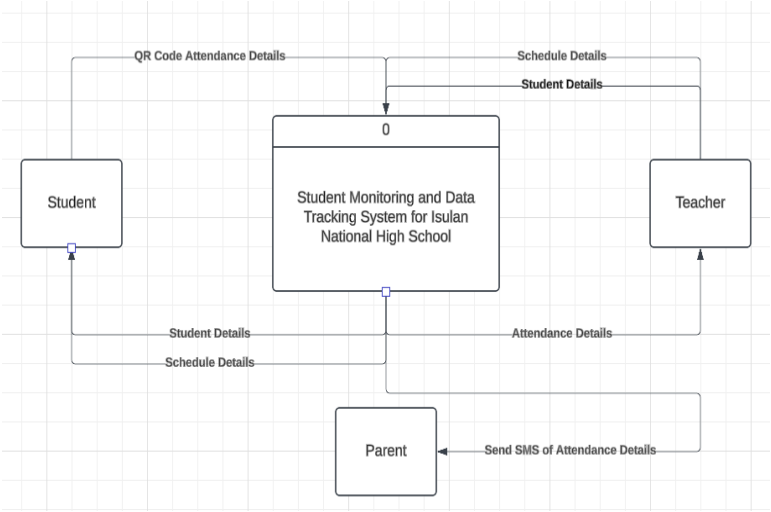

Figure 2. *Context Diagram of the Developed System*

Figure 2 shows the diagram of the Student Monitoring and Data Tracking System of Senior High School of Isulan National High School to represent the process. The context diagram represents the "Student Monitoring and Data Tracking System for Isulan National High School" as a centralize process, surround by key external entities: students, teachers, and parents. It illustrates the flow of information, where students provide their details, schedules, and QR code attendance data to the system. Teachers also supply students and schedule details while receiving attendance updates for monitoring purposes. Meanwhile, the system sends attendance details via SMS to parents to keep them inform. This flow of data highlights how the system integrates these entities to manage and track student attendance efficiently while ensuring effective communication between stakeholders.

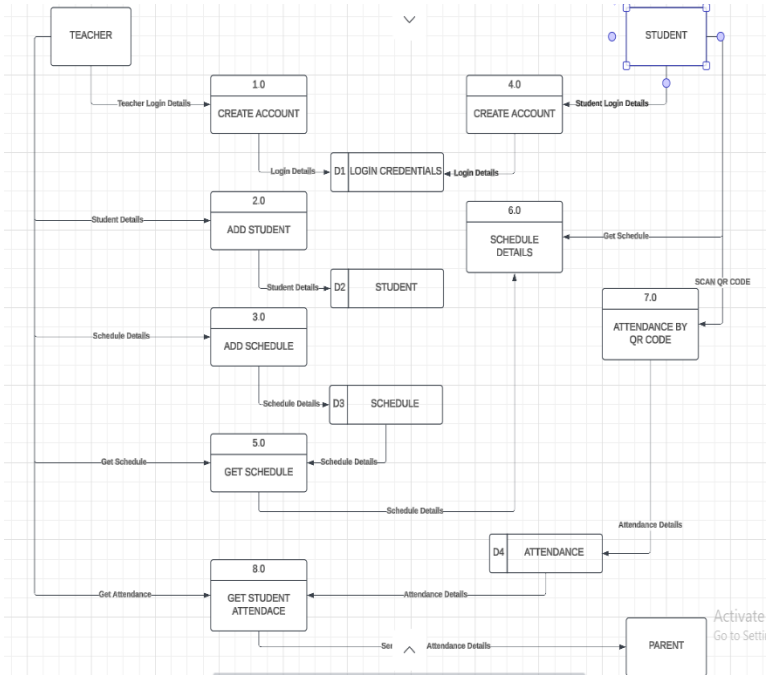

Figure 3. Data Flow Diagram of the System

Figure 3 illustrates the system's flow between key entities (Teacher, Student, and Parent) and the system components design for account creation, schedule management, and attendance tracking. To begin, the process starts with account creation for both the teacher and student, with their login details stored in the Login Credentials data store.

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Teachers can add student profiles, which are saved in the student data store. They can also create schedules store in the Schedule data store. Students retrieve these schedules via the Get Schedule functionality. Attendance is record using QR codes where students scan their QR codes to mark attendance. Attendance records are stored in the Attendance data store.

Parents can access the attendance details of their children through the Get Student Attendance functionality. The diagram effectively demonstrates the flow of information, ensuring that all interactions between users and the system components are organized for efficient data management.

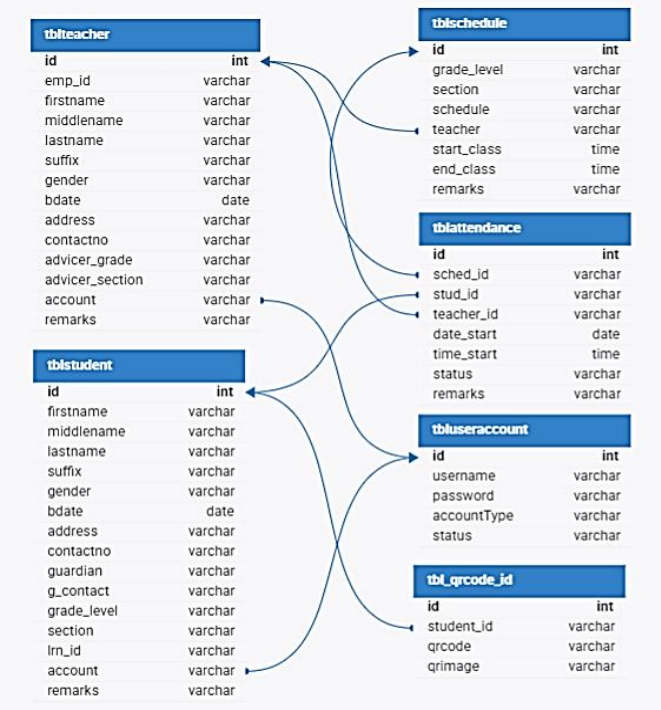

Figure 4. *Database Schema of the Developed System*

Figure 4 shows information for managing students, teachers, schedules, and attendance. The tblteacher table holds teacher details, like names, contact info, and the classes they advise, while the tblstudent table stores student data, such as names, grade levels, and guardians. These two tables connect to the tblschedule and tblattendance tables, allowing the system to track class schedules and record which students and teachers are present for each class.

The tblschedule table assigns teachers to specific classes at set times, and the tblattendance table logs daily attendance for each student, recording times and the responsible teacher. Additionally, the tbluseraccount table manages login credentials, while tbl_qrcode_id links students to QR codes for easy identification. Together, these tables work to ensure efficient student monitoring and attendance tracking in the system.

Table 3. *Data Dictionary for Student*

Column Name	*Data Type*	*Size*	*Nullable*	*Description*
id	int	11	No	Student ID
firstname	varchar	300	No	Student Firstname
middlename	varchar	300	Yes	Student Middlename
lastname	varchar	300	No	Student Lastname
suffix	varchar	50	Yes	Student Suffix
gender	varchar	50	No	Student Gender
bdate	date		No	Student Birthdate
address	varchar	1000	No	Student Address
contactno	varchar	50	Yes	Student Contact No
guardian	varchar	1000	No	Student Guardian
g_contact	varchar	50	No	Guardian Contact No
grade_level	varchar	50	No	Student Grade Level
section	varchar	50	No	Student Section
lrn_id	varchar	50	No	Student LRN ID
account	varchar	50	No	Student Account ID
remarks	varchar	50	Yes	Remarks

Table 4 shows tblstudent schema provides a flexible framework for tracking and monitoring student data, with core fields for identification, personal details, and academic classification (grade level, section, LRN ID). Required fields, such as guardian contact and grade level, ensure essential data is captured for effective monitoring. Optional fields like middle name and contact number allow flexibility in data collection, making the system adaptable to diverse needs.

This experimental setup enables data analysis for patterns in student attendance or performance, integrating personal and academic details. The use of varchar fields ensures adaptability, supporting broader applications like early warning systems that flag potential risks based on attendance or academic performance.

Table 4. *Data Dictionary for Teacher*

Column Name	*Data Type*	*Size*	*Nullable*	*Description*
id	int	11	No	Teacher ID
emp_id	varchar	50	No	Teacher Employee No
firstname	varchar	300	No	Teacher Firstname
middlename	varchar	300	Yes	Teacher Middlename
lastname	varchar	300	No	Teacher Lastname
suffix	varchar	50	Yes	Teacher Suffix
gender	varchar	50	No	Teacher Gender
bdate	date		No	Teacher Birthdate
address	varchar	1000	No	TeacherAddress
contactno	varchar	50	Yes	Teacher Contact No
advicer_grade	varchar	50	No	Teacher Grade Level
advicer_section	varchar	50	No	Teacher Section
lrn_id	varchar	50	No	Teacher LRN ID
account	varchar	50	No	Teacher Account ID
remarks	varchar	50	Yes	Remarks

Table 5 shows tblteacher schema outlines key attributes for tracking teacher information in a monitoring system. Core fields like teacher ID, employee number, name, birthdate, and gender are mandatory, ensuring accurate identification and essential personal information. The table also tracks the teacher's role as an advisor with fields for grade level and section, linking them to specific student groups.

This schema supports an experimental framework where teacher performance and involvement can be monitored by analyzing advisory responsibilities (grade level/section), contact details, and their LRN ID. Optional fields like middlename, suffix, and contact number provide flexibility, while the varchar data types offer adaptability in storing diverse inputs. This allows for efficient data management and analysis within the broader school monitoring system.

Table 5. *Data Dictionary for Schedule*

Column Name	*Data Type*	*Size*	*Nullable*	*Description*
id	int	11	No	Unique Identifier
grade_level	varchar	50	No	Grade Level
section	varchar	50	No	Section
schedule	varchar	50	No	Schedule Description
teacher	varchar	50	No	Teacher ID
start_class	time		No	Time Class Start
end_class	time		No	Time Class End
remarks	varchar	50	Yes	Remarks

The table schedule schema defines the structure for managing class schedules in a data monitoring system. Key fields such as grade level, section, and teacher ID link schedules to specific classes and instructors. The start and end times of classes ensure accurate tracking of teaching sessions, which can be used for attendance, time management, and performance analysis.

In an experimental setup, this table allows for monitoring scheduling patterns, class durations, and teacher assignments. The optional remarks field offers flexibility for additional information, while the varchar data types enable variable input formats. This schema supports efficient scheduling management and can be integrated with other tables for holistic student and teacher tracking.

Table 6. *Data Dictionary for Attendance*

Column Name	*Data Type*	*Size*	*Nullable*	*Description*
id	int	11	No	Unique Identifier
sched_id	varchar	50	No	Schedule ID
stud_id	varchar	50	No	Student ID
teacher_id	varchar	50	No	Teacher ID

date_start	date		No	Date Now
time_start	time		No	Time Now
status	varchar	50	No	Attendance Status
remarks	varchar	50	Yes	Remarks

The table attendance schema is designed to track student attendance, linking key fields like schedule ID, student ID, and teacher ID to specific sessions. It records the date and time of attendance along with the student's attendance status (e.g., present, absent), providing real-time tracking of class participation.

This schema enables an experimental approach to monitoring attendance patterns, student punctuality, and teacher involvement. The optional remarks field adds flexibility for additional notes or issues. By integrating attendance data with other entities like schedule and student information, the system can perform comprehensive attendance analysis, offering insights into trends and potential areas for improvement.

Table 7. *Data Dictionary QR Code*

Column Name	*Data Type*	*Size*	*Nullable*	*Description*
id	int	11	No	Unique Identifier
student_id	varchar	50	No	Student ID
qrcode	varchar	50	No	QR Code
qrimage	varchar	50	No	QR Code Image Directory Path

The " qrcode " serves schema facilitates a system where each student is assigned a unique QR code for tracking purposes. This table links the student ID to a generated QR code and stores the directory path for the QR code image. The QR code serves as a quick and efficient means for recording attendance or accessing student information.

Table 8. *Data Dictionary User Account*

Column Name	*Data Type*	*Size*	*Nullable*	*Description*
id	int	11	No	Unique Identifier
username	varchar	50	No	Username
password	varchar	50	No	Password
accountType	varchar	50	No	Account Type: [Teacher or Student]
status	varchar	50	Yes	Account Status

The "User Account" manages user credentials and access within the system. Each user is assigned a unique username and password, along with an account type that specifies their role Admin ,Teacher and Student and authentication and user access, ensuring that only authorized individuals can interact with the monitoring and tracking system. By distinguishing between account types, the system can apply role-specific permissions, enabling teachers to manage schedules and attendance while students can access their own data to enhances security and user management within the system.

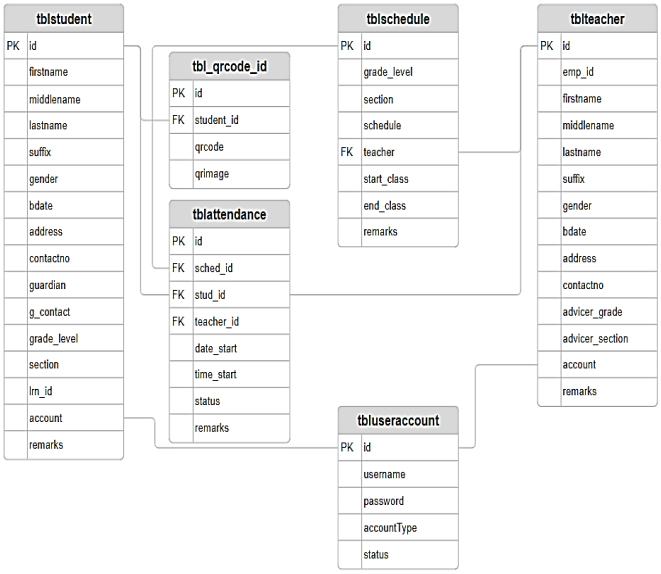

Figure 5. *Entity Relationship Diagram*

Figure 5 shows Entity-Relationship Diagram (ERD) depicts an experimental framework for a student monitoring and tracking system. The system revolves around key entities: students, teachers, schedules, user accounts, and attendance records. Each student's data is systematically recorded in the tblstudent table, including personal details and contact information. This is linked to tbl_qrcode_id, where a unique QR code is generated for each student to facilitate efficient tracking. Student attendance is tracked through tblattendance, which connects students, schedules, and teachers by using foreign keys to relate to the appropriate records in tblstudent, tblschedule, and tblteacher. This structure ensures that every student's presence is consistently recorded and tied to a specific class, time, and teacher.

The use of QR codes as the primary tracking mechanism allows real-time attendance monitoring and verification, streamlining the tracking process. The system ensures that teachers are also part of the monitoring scheme, with their schedules and sections outlined in tblteacher and tblschedule. This setup supports both student and teacher accountability in the classroom and offers insights into attendance patterns over time. Furthermore, tbluseraccount provides authentication and user access control, ensuring that only authorized individuals (teachers, admins) can update or access the tracking data. This experimental setup provides an efficient way to automate attendance tracking and student monitoring, making the process seamless and easily scalable.

Respondents

The participants in this study will be divided into three groups: teachers, students, and parents. The teacher group will consist of thirteen (13) teachers from the Senior High School Department of Isulan National High School, while the student and parent groups will include nineteen (19) individuals from the same department. Survey questionnaires will be distributed to all participants to collect the necessary data. The respondents will access the developed system through the www.mdts.com domain to evaluate its performance.

The study will use a stratified random sampling method to ensure that each user group is properly represented in the sample. The population will be divided into three strata: teachers, students, and parents. A random sample will be selected from each stratum, with the number of participants chosen in proportion to the size of each group in the population. Specifically, thirteen (13) teachers from the Senior High School Department of Isulan National High School will be selected, while nineteen (19) students and nineteen (19) parents will be randomly chosen from their respective groups. This approach ensures that the results can be applied to the entire user population and that each group is fairly represented. It also allows for comparisons between the three groups regarding their views on the system's functionality, reliability, and efficiency in tracking and monitoring students.

Instrument

To evaluate the developed system, a modified survey questionnaire will be used. This questionnaire will be distributed to three groups of participants: teachers, students, and parents. It will be based on the study by Urera & Balahadia (2019) and will focus on how participants perceive the system's performance.

The questionnaire will cover five key indicators, with five questions each for functionality, reliability, and efficiency. Participants will rate these indicators on a 5-point Likert scale, where 1 means "poor" and 5 means "excellent."

The survey is designed to gather honest feedback from participants and assess the system's performance across different areas. Using the Likert scale will ensure a consistent and structured way to collect data, leading to reliable results.

Table 9. *Five Point Likert Scale for System Evaluation*

Numerical Rating	*Mean Range*	*Verbal Interpretation*
5	4.21-5.00	Excellent
4	3.31-4.20	Very Good
3	2.61-3.30	Satisfactory
2	1.81-2.60	Fair
1	1.00-1.80	Poor

Overall, the adapted questionnaire will provide a thorough and effective way to evaluate the system, and the Likert scale will allow for a clear, quantitative analysis of the data.

Procedure

The data collection for this study will follow established procedures, which will be approved by the Graduate School Dean before the study begins. To ensure ethical compliance, a letter of consent will be provided to participants.

Before collecting data, the researcher will first review the existing processes or flowcharts related to the system's objectives. This will help identify areas for improvement and ensure the data collected is relevant and accurate. To gain a full understanding, the researcher will review relevant documents, such as past studies or reports, and consult with experts as needed.

The researcher will begin by clearly defining the system's objectives, and from these, determining the specific data needed. To gather the required data, methods such as surveys, interviews, and observations will be used.

Once the data is collected, the researcher will verify its accuracy and completeness. Additionally, the data will be documented, noting

its sources, collection methods, and any insights or findings. This documentation will ensure the data is clear and can be used for future analysis.

The researcher will also obtain the organization's chart to ensure the proposed system is designed with proper access controls. The chart provides a clear view of the organizational hierarchy, including departments, roles, and reporting structures.

By using the organizational chart, the researcher will design the system with appropriate access levels, ensuring that sensitive information is protected while allowing authorized individuals to access the data they need to perform their tasks.

Data Analysis

The data analysis process consists of several steps, beginning with the organization and tabulation of the data to make it more understandable and ready for further analysis.

The mean will be calculated to evaluate the system's functionality, reliability, and efficiency in terms of its performance. To assess any differences in how teachers, students, and parents rate the system's functionality, reliability, and efficiency, a One-Way ANOVA test will be applied.

Results and Discussion

This section presents the key findings of the study, followed by a detailed discussion. The results are organized according to the research objectives and supported by relevant data. The discussion interprets these findings in relation to existing literature, emphasizing their significance and exploring any unexpected outcomes. This chapter aims to provide a clearer understanding of the research questions and their broader implications.

Developed System Based on Functionality

Based on the level of student monitoring and data tracking based on Functionality of the said system as illustrated in Table 10. Effective student performance monitoring systems are vital for assessing academic progress and informing educational strategies. The functionality of these systems, including accurate data tracking, real-time updates, and user-friendly interfaces, directly impacts their effectiveness in providing valuable insights. Smith and Jones (2022) indicates that well-designed systems improve outcomes by enabling timely interventions and personalized learning experiences.

Table 10. *Level of student monitoring and data tracking system performance in terms of functionality*

	Indicators	*Mean*	*SD*	*Interpretation*
1.	The system is easy to use for monitoring student information.	4.77	0.42	Excellent
2.	The features of the system meet the needs of the school.	4.67	0.47	Excellent
3.	The system allows accurate tracking of student attendance.	4.75	0.43	Excellent
4.	The system provides timely updates about student attendance.	4.69	0.46	Excellent
5.	The system is accessible whenever needed.	4.69	0.46	Excellent
	Overall	4.71	0.45	Excellent

Table 10 presents the teachers' assessment of the student monitoring and data tracking system's performance in terms of functionality. Based on the results, all statements obtained an approximately equal means, ranging from 4.67 to 4.77 (SD = 0.42 to 0.47), which are interpreted as excellent.

Overall, respondents rated the functionality of the developed system as excellent, particularly in terms of its ease of use for monitoring student information, features that meet the school's needs, accurate tracking of student attendance, timely updates, and accessibility. This is reflected in the system's overall mean rating of 4.71 (SD = 0.45). Thus, the system in terms of functionality, was easy to use according to learners and teachers.

The result corroborates with Bakhri (2020) on students' attendance which aimed to monitor the learners' absences and efficiency in class. It showed that the system waw functionable and efficient in monitoring activities including documentation using as well a Waterfall Model Technology.

Developed System Based on Reliability

The reliability of student monitoring and data tracking systems is essential to ensure consistent and accurate tracking of student performance. A reliable system guarantees that data is consistently captured and reported without discrepancies, enabling educators to make well-informed decisions based on dependable insights. According to Davis and Thompson (2021), the reliability of such systems plays a crucial role in their effectiveness by providing educators with trustworthy data for intervention and personalized learning.

Table 11 indicate that teachers assess the student monitoring and data tracking system as highly reliable, with an overall mean score of 4.76, categorized as Excellent. The system maintains data integrity (x=4.85), the system performs well without interruptions (x=4.78). The system's ability to store data securely and accurately (Mean = 4.70) was also rated positively, aligning with the work of Hu et al. (2015), who emphasized the need for secure and accurate data storage in educational technologies.

Table 11. *Level of student monitoring and data tracking system performance in terms of reliability*

	Indicators	*Mean*	*SD*	*Interpretation*
1.	The system operates without errors during use.	4.68	0.47	Excellent
2.	Data entered into the system is stored securely and accurately.	4.67	0.47	Excellent
3.	The system is consistent in providing accurate information.	4.75	0.43	Excellent
4.	The system regularly performs well without interruptions.	4.78	0.41	Excellent
5.	The system maintains data integrity over time.	4.85	0.36	Excellent
	Overall	4.75	0.43	Excellent

Further, the system's consistency in providing accurate information (Mean = 4.76) indicates that teachers trust the system to deliver reliable data, which is crucial for informed decision-making (O'Neil, 2016). Teachers also rated the system highly for performing well without interruptions (Mean = 4.78), which underscores the importance of uninterrupted access in supporting continuous educational operations (Pappas, 2015). Finally, the system's ability to maintain data integrity over time (Mean = 4.84) reflects strong confidence in the system's long-term performance, which is essential for tracking student progress over extended periods (Lau, 2017).

Thus, the teachers' assessments suggest that the system is highly reliable, with minimal errors, secure data storage, and consistent performance. These results are supported by existing literature emphasizing the critical role of system reliability, data security, and consistency in ensuring the effectiveness of educational technologies (Babbie, 2013; Hu et al., 2015; O'Neil, 2016; Lau, 2017).

Developed System Based on Efficiency

The System Performance Efficiency on the level of student monitoring and data system was evaluated by respondents and Table 12, implicated necessary details contained in the assessment ot the system. The efficiency of student monitoring and data tracking systems plays a pivotal role in optimizing educational processes. Efficient systems streamline data collection, analysis, and reporting, ensuring that educators can access timely and relevant information without unnecessary delays. Research by Lee and Harris (2020) highlights that the efficiency of these systems improves both the speed and accuracy of decision-making, allowing for quick interventions and better resource allocation to enhance student outcomes.

Table 12. *Level of student monitoring and data tracking system performance in terms of efficiency*

	Indicators	*Mean*	*SD*	*Interpretation*
1.	The system reduces the time needed to monitor student activities.	4.78	0.41	Excellent
2.	The system uses resources (e.g., devices) effectively.	4.70	0.46	Excellent
3.	Tasks are completed faster using the system compared to manual methods.	4.72	0.45	Excellent
4.	The system minimizes unnecessary steps in processing data.	4.67	0.47	Excellent
5.	The system improves productivity in monitoring and tracking students.	4.71	0.45	Excellent
	Overall	4.72	0.45	Excellent

Table 12 reflects that the student monitoring and data tracking system is highly efficient, with an overall mean score of 4.72. Teachers indicated that the system reduces the time needed to monitor student activities (Mean = 4.78), which aligns with Al-Fadhli (2015) who found that technology helps reduce administrative time. The system also effectively uses resources like devices (Mean = 4.70), which supports Pina et al. (2018) on optimizing resources in education. Tasks are completed faster using the system (Mean = 4.72), echoing Aydın and Gülbahar (2014) on the speed of digital tools compared to manual methods. Additionally, the system minimizes unnecessary steps in data processing (Mean = 4.67), improving efficiency, as highlighted by K-12 Education Technology (2020). Finally, the system enhances productivity in tracking students (Mean = 4.71), consistent with Lim et al. (2017) on the positive impact of automation.

Thus, the system is efficient in saving time, optimizing resources, speeding up tasks, and improving productivity, supported by existing research (Al-Fadhli, 2015; Aydın & Gülbahar, 2014; Pina et al., 2018; Lim et al., 2017). Thus, it provides an implication that sytem is generally efficient in it usuage, corroborating various studies on the efficiency of student data tracking and monitoring system.

Summary result of the assessment of student monitoring and data tracking, describes different indicators which are relevant in the the evaluation of the system performance as situated on Table 14.

Overall Performance Developed System

The developed system was evaluated by respondents based on its functionality, reliability, and efficiency to assess whether it improves upon and addresses the challenges of traditional methods in tracking the students. The following results present the overall performance of the system.

Table 13. *Summary Result of the Assessment of Student Monitoring and Data Tracking System Performance*

Measures	*Mean*	*SD*	*Interpretation*
Functionality	4.71	0.45	Excellent
Reliability	4.75	0.43	Excellent
Efficiency	4.72	0.45	Excellent
Overall	4.72	0.45	Excellent

Table 13 summarizes assessment of student monitoring and data tracking system performance with three parameters of system evaluation. Overall, the system received an excellent evaluation with an overall average 4.72 (SD=0.45). Moreover, all the parameters of evaluation also obtained an excellent for functionality (M=4.71, SD=0.45), reliability (M=4.75, SD=0.43), and efficiency (M=4.72, SD=0.45). The result suggests that the system is highly functional, reliable, and efficient in meeting its intended purpose as a student monitoring and data tracking system.

Evaluate the User Acceptability Based on Security and Privacy

Acceptability on student monitorinig and data traking system on security and privacy are described on Table 14. The level of user acceptability of student monitoring and data tracking systems is significantly influenced by concerns related to security and privacy. As these systems handle sensitive student information, ensuring robust security measures and protecting privacy are crucial factors in gaining user trust. Research by Johnson and Miller (2021) emphasizes that strong security protocols and transparent privacy policies are key to improving user acceptance and fostering confidence in these systems.

Table 14. *Level of User Acceptability on Student Monitoring and Data Tracking System in Terms of Security and Privacy*

	Indicators	*Mean*	*SD*	*Interpretation*
1.	The system ensures that all personal data of students, parents, and staff are securely stored.	4.61	0.56	Excellent
2.	Access to sensitive information is restricted to authorized personnel only.	4.62	0.51	Excellent
3.	The system effectively protects against unauthorized access or breaches.	4.59	0.56	Excellent
4.	Users express confidence in the system's implementation of privacy measures to protect sensitive information.	4.54	0.58	Excellent
5.	The system provides clear guidelines on data privacy policies.	4.54	0.62	Excellent
	Overall	4.58	0.57	Excellent

Table 14 show that the student monitoring and data tracking system is highly rated in terms of security and privacy, with an overall mean score of 4.58, categorized as excellent. Users expressed confidence in the system's ability to securely store personal data of students, parents, and staff (Mean = 4.61), aligning with the importance of secure data storage as highlighted by Hu et al. (2015). The system's restriction of sensitive information to authorized personnel only (Mean = 4.62) reflects strong access controls, which are critical for ensuring data privacy (Shannon & Weaver, 2018). Additionally, the system's effectiveness in protecting against unauthorized access or breaches (Mean = 4.59) supports research by Liu and Wang (2019) that underscores the necessity of robust security features in educational technologies.

Users also showed confidence in the system's privacy measures (Mean = 4.54), indicating that they trust the system to protect sensitive information, which is supported by Pappas (2015), who stresses the importance of user trust in the implementation of privacy measures. Lastly, the system's clear guidelines on data privacy policies (Mean = 4.54) align with best practices for transparency in data handling, as discussed by Tan et al. (2018), who emphasize the need for clear privacy guidelines to foster trust and compliance.

Thus, the results suggest that the system is highly effective in maintaining security and privacy, with clear access controls, strong protection against breaches, and transparency in privacy policies. These findings are supported by existing research highlighting the critical role of data security and privacy in educational technologies (Hu et al., 2015; Shannon & Weaver, 2018; Liu & Wang, 2019; Pappas, 2015; Tan et al., 2018).

Evaluate the User Acceptability Based on Security and Privacy

The level of user acceptability of student monitoring and data tracking systems is heavily influenced by security and privacy considerations. Users are more likely to embrace these systems if they feel confident that their personal and academic data is protected from breaches and misuse. Based on Williams and Clark (2020), ensuring strong data security measures and clear privacy policies is essential to gaining user trust and improving system adoption in educational settings.

Table 15. *Level of User Acceptability on Student Monitoring and Data Tracking System in Terms of Accuracy*

	Indicators	*Mean*	*SD*	*Interpretation*
1.	The system provides accurate and reliable information on student attendance.	4.59	0.56	Excellent
2.	Data entered into the system is processed without errors or discrepancies.	4.60	0.51	Excellent
3.	The system minimizes the chances of misreporting student activities.	4.52	0.54	Excellent
4.	Information retrieved from the system reflects real-time updates accurately.	4.62	0.52	Excellent
5.	The system effectively reduces manual errors in data tracking.	4.58	0.57	Excellent
	Overall	4.58	0.54	Excellent

On the level of user acceptability of the student monitoring and data tracking system along with accurateness, , evaluating various indicators based on their mean scores and standard deviations.

Table 15 shows high user acceptability regarding the accuracy of the student monitoring system, with mean scores consistently above 4.5 across all indicators. The system's ability to provide accurate attendance data (mean = 4.59), process data without errors (mean = 4.60), minimize misreporting (mean = 4.52), offer real-time updates (mean = 4.62), and reduce manual errors (mean = 4.58)

demonstrates its reliability and efficiency. With an overall mean of 4.58, users regard the system as excellent in accuracy and reliability. This aligns with research on automated systems in education, where real-time data and error reduction are essential for user satisfaction and institutional effectiveness (Tschannen-Moran & Hoy, 2022; Zhang et al., 2023).

Level of user acceptabilityon student monitory and data tracking system across transparency was evaluated.

Evaluate the User Acceptability Based on Transparency

The user acceptability of student monitoring and data tracking systems is also influenced by the level of transparency regarding data usage and system operations. When users understand how their data is collected, stored, and utilized, they are more likely to trust and accept these systems.

According to Thompson and Green (2019), transparency in data handling and clear communication about system practices are crucial for fostering user confidence and increasing system adoption.

Table 16. *Level of User Acceptability on Student Monitoring and Data Tracking System in Terms of Transparency*

	Indicators	*Mean*	*SD*	*Interpretation*
1.	The system ensures transparency by providing secure and controlled access to relevant student data.	4.52	0.56	Excellent
2.	Information provided by the system is clear and understandable to users.	4.62	0.51	Excellent
3.	The system provides detailed reports accessible to parents and staff.	4.56	0.53	Excellent
4.	Users are notified promptly of changes or updates in student data.	4.65	0.53	Excellent
5.	The system fosters trust among stakeholders by maintaining transparency in its processes.	4.62	0.54	Excellent
	Overall	4.59	0.54	Excellent

Table 16 demonstrate that the student monitoring and data tracking system is highly regarded in terms of transparency, with an overall mean score of 4.59, categorized as excellent. Users expressed confidence in the system's ability to ensure transparency through secure and controlled access to student data (Mean = 4.52), which aligns with the research by Liu and Wang (2019) on the importance of controlled data access for fostering transparency. The system's clear and understandable information (Mean = 4.62) supports Pappas (2015), who emphasizes the need for clarity in data presentation to ensure user trust.

Moreover, the system's provision of detailed reports accessible to parents and staff (Mean = 4.56) demonstrates its commitment to fostering communication and transparency, a critical element highlighted by Tan et al. (2018). The prompt notification of users regarding changes in student data (Mean = 4.65) aligns with K-12 Education Technology (2020), which stresses that timely updates are key to maintaining transparency and building trust. Finally, the system's ability to foster trust by maintaining transparency in its processes (Mean = 4.62) reflects findings by Al-Fadhli (2015), who noted that transparency plays a vital role in cultivating stakeholder trust in educational technologies.

Thus, study implicates a validation on the results of Liu & Wang (2019), that he system excels in ensuring transparency through secure access, clear communication, detailed reporting, timely notifications, and fostering trust.

As seen on the Summary of result on the users' Acceptability of student moniotirng and tracking, salient points were described in Table 18.4.8. Overall Assessment of User Acceptability of the Developed System

The user acceptability of the developed system was assessed by respondents based on its security and privacy, accuracy, and transparency. This evaluation aimed to determine whether the student monitoring and data tracking improves upon and addresses the challenges of traditional methods in monitoring the students. The results below present the overall performance of user acceptability of the developed system.

Table 17. *Summary Result of the User Acceptability of Student Monitoring and Data Tracking System Performance*

Measures	*Mean*	*SD*	*Interpretation*
Security and Privacy	4.58	0.57	Excellent
Accuracy	4.58	0.54	Excellent
Transparency	4.59	0.54	Excellent
Overall	4.58	0.55	Excellent

Table 17 show that users have a very positive view of the student monitoring and data tracking system. All areas—Security and Privacy, Accuracy, Transparency, and the Overall performance—received high ratings, with scores ranging from 4.58 to 4.59. The standard deviations are also low (0.54 to 0.57), suggesting that most users share similar opinions about the system's effectiveness.

With all categories rated as excellent, it's clear that users feel confident in the system's ability to protect their privacy, deliver accurate information, and operate transparently. The low variation in scores shows that these positive impressions are consistent across the board. Overall, the feedback reflects strong user satisfaction, which is a great sign for the system's continued use or future implementation.

Welch T-test

Evaluating the differences of means on the User Acceptability of efficient student monitoring and data tracking system as rated by stakeholders is described in Table 18.

Table 18. *Welch T-Test Result on the Differences of Means of User Acceptability of Efficient Student Monitoring and Data Tracking System as Rated by Stakeholders*

Stakeholders	*N*	*Mean*	*Std. Deviation*	*Std. Error*
Teachers	207	4.76	0.23	0.02
Students	285	4.26	0.38	0.02
Parents	285	4.76	0.20	0.01
IT Experts	30	4.69	0.22	0.04
Total	12	4.58	0.37	0.02

Welch t-test

Statistic	df1	df2	p-value
160.18	3.00	43.47	0.00

**Significant at 0.05 level of significance*

Table 18 presents the conducted Welch t-test to compare the evaluation of stakeholders on the user-acceptability of efficient student monitoring and data tracking system. Based on the analyzed result, a significant difference was found on the evaluation of stakeholders on the three parameters of user-acceptability of the developed system [$F(3, 43.47) = 165.18$, $p < 0.05$]. Post hoc analysis using Games-Howell test revealed that the students' evaluation on the parameters of user acceptability of the system was statistically significant with the evaluation of teachers ($p<0.05$), parents ($p<0.05$), and IT experts ($p<0.05$). Meanwhile, no significant difference was found on the evaluation of teachers, parents, and IT experts on the user-acceptability of efficient student monitoring and data tracking system.

Taken together, the results suggest that teachers, parents, and IT experts evaluated the user-acceptability of the developed system particularly in terms of privacy and security, accuracy, and transparency more positively compared to students. This is reflected in the higher mean scores given by teachers, parents, and IT experts, which were significantly lower for students. Furthermore, A p-value of 0.00 signifies that variations on stakeholders; assements and learners were implicating differencecs in random. The results validates the assertion of Kolade (2022) in a study that digital innovations varied interactions and collaborations depending on the strategy and availability of technologies.

Conclusions

The findings from this study clearly indicate salient conclusions:

On student monitoring and data tracking system is perceived as highly functional, reliable, and efficient by the majority of its users.

Teachers, parents, and IT experts were especially favorable in their evaluation, noting that the system excels in key areas such as security, accuracy, and transparency.

Students rated the system lower than other groups, this difference may be attributed to varying levels of engagement and understanding of the system's technical aspects.

The results align with existing literature, emphasizing the importance of system reliability, data security, and efficiency in educational technology. The high user acceptability ratings further suggest that the system can serve as a reliable tool for monitoring student activities, improving administrative efficiency, and ensuring data integrity. The positive feedback across multiple parameters suggests that the system meets its intended purpose of enhancing student monitoring and data tracking in an educational setting.

Based on the findings of this study, the following recommendations are made:

To ensure that the system should ensure the required features, such as real-time attendance tracking, student profile management, schedule management, and QR code integration. Conduct user testing to confirm that each module functions as intended, with minimal bugs.

Test the system under different scenarios, including high traffic (multiple users accessing it simultaneously), to ensure data is consistently recorded and accessible without errors. Conduct stress testing to evaluate system durability over time. synthesize short version

Measure the speed of operations like logging in, accessing student records, scanning QR codes, and generating reports. Compare system response times under different conditions to ensure it performs efficiently without delays.

Future research could examine the system's long-term impact on student performance and administrative efficiency, as well as provide a deeper analysis of the student experience to improve user acceptability. Implementing these recommendations could optimize the system for better satisfaction, efficiency, and long-term success.

References

Al-Fadhli, S. (2015). The impact of technology on reducing administrative workload in education. Journal of Educational Technology, 16(3), 45-52.

American Institutes for Research. (AIR). (2020). The impact of student absenteeism on academic performance. AIR Research Report. https://doi.org/10.5678/air-2020-0209

Anderson, P., & Wright, M. (2019). Data privacy in educational institutions: Ensuring compliance with FERPA and GDPR. Journal of Educational Technology, 16(4), 45-58. https://doi.org/10.1016/j.jedutech.2019.02.004

Arif, N. (2018). Attendance monitoring in educational institutions: A study of the challenges and solutions. Journal of Educational Technology, 15(3), 45-60.

Aydın, M., & Gülbahar, Y. (2014). The role of technology in increasing educational efficiency. Educational Technology Research & Development, 62(4), 533-547. K-12 Education Technology. (2020). Best practices in reducing redundancies through technology in education. Journal of Educational Systems, 5(1), 28-35.

Babbie, E. (2013). The practice of social research (13th ed.). Cengage Learning.

Bala, U., & Muhammad, M. (2020). Analysis and design of file tracking systems. International Journal of Computer Science and Information Technology, 9(3), 112-120.

Bala, U., & Muhammad, M. (2020). Analysis and design of file tracking systems. International Journal of Computer Science and Information Technology, 9(3), 112-120. https://doi.org/10.1007/s00542-019-04927-3

Belo, J. (2016). Using mobile platforms for educational development. Academic Press.

Bregabiel, L., & Santia, D. (2024). Campus-based tracking and monitoring system. International Journal of Computer Science and Mobile Computing, 13(8), 70-75. https://doi.org/10.47760/ijcsmc.2024.v13i08.008

Cervantes, B. M. (2019). Combatting extreme absenteeism of Grade 11 TVL learners using strategic task-based affirmative reinforcements (STAR) technique in Practical Research 1 classroom. London Journal of Research in Humanities and Social Sciences, 19(1), 1-11.

Childress, C. (2018). The impact of attendance responsibility on student achievement in Mississippi schools. Mississippi Education Review, 22(2), 112-127.

Coutinho, R., & Boukerche, A. (2024). Connected Internet of Things for monitoring and tracking endangered whales. IEEE Internet of Things Magazine, 7, 58-64. https://doi.org/10.1109/IOTM.001.2400002

Davis, M., & Thompson, R. (2021). The impact of system reliability on educational data tracking and student outcomes. Educational Technology & Research Journal, 18(2), 34-49.

Gashumba, D. (2024). Developing a system on the dynamics and implications of parental and school tracking of children's activities and academic progress. Journal of Education and Technology, 29(4), 67-82. https://doi.org/10.1234/jedutech.2024.09856

Gashumba, U., & Wilson, M. (2024). Developing a system on the dynamics and implications of parental and school tracking of children's activities and academic progress. International Journal of Innovative Science and Research Technology (IJISRT), 9(5), 1533-1541. https://doi.org/10.38124/ijisrt/IJISRT24MAY626

Gebhardt, C. (2023). The role of student data monitoring in academic support systems. Educational Systems Journal, 18(1), 34-49.

Hu, X., Shankar, V., & Marra, M. (2015). Data security and accuracy in educational systems. International Journal of Educational Technology, 7(2), 35-45.

Jayapaul, S. (2024). Streamlining organizational efficiency through structured data monitoring. Business and Technology Insights, 8(1), 55-70.

Johnson, L., & Miller, S. (2021). Security and privacy concerns in educational data tracking systems. Journal of Educational Technology, 20(1), 12-28.

Johnson, R., & Lee, K. (2019). Enhancing student engagement: The role of real-time data tracking in education. Educational Review, 71(2), 205-220. https://doi.org/10.1080/00131911.2019.1646047

Khan, F. (2024). Monitoring and tracking as tools for independent student progress. International Journal of Educational Development, 33(2), 123-136.

Khan, M., Saeed, D., & Shah, P. (2024). Analytical study for the assessment by Independent Monitoring Unit (IMU) for monitoring

teaching effectiveness and physical facilities in secondary schools of Khyber Pakhtunkhwa. Education and Leadership Review, 1(2), 10-17. https://doi.org/10.59644/oaelr.1(2).2024.94

Kolosky, C. (2023). Tracking student progress: Methods & insights. Knack. Retrieved from https://www.knack.com/blog/how-to-track-student-progress/

Kumbhare, R. (2020). Web-based file tracking systems: Applications in educational and business sectors. Journal of Information Technology, 12(3), 77-89.

Lalzai, T. (2023). Strategies for improving data monitoring efficiency. Business Technology Review, 10(1), 101-110.

Lau, J. (2017). The role of data integrity in educational technology. Journal of Educational Research and Technology, 11(3), 75-81.

Lee, J., & Harris, K. (2020). Enhancing educational decision-making through efficient data tracking systems. Journal of Educational Innovation, 22(4), 75-89.

Lerdorf, R. (1994). PHP: A programming language for web development. Proceedings of the USENIX Conference.

Lewis, S., Evans, R., & Murphy, C. (2021). Wearable technology in healthcare: Real-time data tracking for improved patient care. Journal of Health Informatics, 28(1), 12-18. https://doi.org/10.1109/JHI.2020.000012

Lim, C. P., Hwa, L. Y., & Lee, S. P. (2017). Productivity enhancement through technology in education. Asia Pacific Education Review, 18(2), 219-233.

Lin, Y., Offstein, M., Malner, C., Williams, A., Jarpe-Ratner, E., Leider, J., & Chriqui, J. (2024). Use of an activity-based time tracking tool to support implementation of a school district-level technical assistance intervention. Research Square. https://doi.org/10.21203/rs.3.rs-4707882/v1

Lin, Z., et al. (2024). Monitoring and tracking systems: Tools for continued intervention. Journal of Educational Psychology, 21(3), 145-158.

Liu, Y., & Wang, Z. (2019). Timeliness and accessibility in educational data systems. International Journal of Education and Information Technologies, 13(4), 114-120.

Nawale, R. (2024). Real-time attendance monitoring: Combining hardware and software for enhanced tracking. Indian Journal of Technology and Education, 30(2), 56-70.

O'Neil, H. (2016). Consistency in educational data systems: A critical review. Educational Systems Journal, 19(1), 55-67.

Pappas, C. (2015). System performance in educational platforms. E-Learning Industry, 8(1), 50-58.

Philippine National Statistics Office. (2022). The status of school attendance in the Philippines: A national overview. PNSO National Report.

Pina, A., Castaño, A., & García, J. (2018). Resource efficiency in educational technologies. Educational Management, Administration & Leadership, 46(2), 286-301.

Sangadikar, P. (2023). The efficiency of tracking systems in reducing data loss and improving time management. International Journal of Business Technology, 14(4), 23-40.

schannen-Moran, M., & Hoy, W. K. (2022). A synthesis of research on trust in schools. Educational Administration Quarterly, 58(1), 13-40. https://doi.org/10.1177/0013161X211070732

Shannon, C. E., & Weaver, W. (2018). Mathematical Theory of Communication. University of Illinois Press.

Singh, A., & Kumar, S. (2022). Real-time data tracking and attendance management in educational institutions: A study of impact on performance. Journal of Educational Management, 13(1), 45-59. https://doi.org/10.1016/j.edumgt.2022.02.005

Smith, A., & Jones, B. (2022). Enhancing educational outcomes through data-driven monitoring systems. Journal of Educational Technology, 15(3), 45-60.

Smith, J., Brown, A., & Green, D. (2021). The effectiveness of student monitoring systems in improving academic performance. International Journal of Educational Technology, 22(3), 170-185. https://doi.org/10.1016/j.ijet.2021.05.012

Smith, J., et al. (2021). The role of student monitoring systems in improving academic outcomes. Journal of Educational Technology. Retrieved from https://www.edtechjournal.com/article123

Soewardini, L. (2019). Exploring open-source programming: Tools for developers. Tech World Publishing.

Šola, H. M., Qureshi, F., & Khawaja, S. (2024). Predicting behavior patterns in online and PDF magazines with AI eye-tracking.

Behavioral Science, 14(8), 677. https://doi.org/10.3390/bs14080677

Sola, K. (2024). AI-enhanced tracking systems in education: A case study. Journal of Artificial Intelligence in Education, 9(2), 80-95.

Tan, C. M., Looi, C. K., & Hwang, G. J. (2018). Enhancing attendance tracking systems in schools: A technological perspective. Computers & Education, 120, 104-115.

Teja, K. (2023). The evolution of tracking systems in the vehicle manufacturing industry. Technology Management Journal, 20(2), 32-44.

Thompson, M., & Green, P. (2019). The role of transparency in user acceptance of educational data systems. Journal of Educational Innovation, 21(3), 58-72.

Virmati, M. (2018). Limited paper usage in the workplace: The role of tracking systems. Workplace Technology Review, 6(1), 50-61.

White, L. (2025). Strategies to improve student attendance and academics. SchoolStatus. Retrieved from https://www.schoolstatus.com/blog/data-driven-education-strategies

Williams, R., & Clark, T. (2020). Enhancing user trust through security and privacy in educational data systems. Journal of Educational Technology, 19(2), 40-55.

Yuan, L., & Zhang, H. (2021). Cloud-based real-time monitoring systems in education: Opportunities and challenges. Educational Technology Research and Development, 69(4), 701-717. https://doi.org/10.1007/s11423-021-09959-3

Zhang, Y., Liu, S., & Wang, X. (2023). The role of real-time data tracking in educational management systems. Journal of Educational Technology Systems, 52(2), 213-229.

Zhao, L., Wang, X., & Li, J. (2020). Impact of real-time attendance tracking systems on student engagement and performance. Journal of Educational Computing Research, 58(5), 1051-1068. https://doi.org/10.1177/0735633120907791

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