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Mobile web-based student portal with qr code for school digitalization

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ABSTRACT

The mobile web-based Student Portal application utilizing QR Barcode technology was developed as a solution to limited access and low efficiency in managing student data within schools. Without the support of this system, processes such as attendance, academic information delivery, and communication between students and educators tend to be slow and prone to recording errors, ultimately affecting the effectiveness of learning and school administration. To address these challenges, a user needs analysis was conducted, an adaptive interface design was created to support various devices (responsive), and QR code scanning was integrated to facilitate attendance and digital access to information. The application development process followed an iterative method, actively involving users during testing stages to obtain relevant feedback. Preliminary results indicate that the implementation of this application can enhance student data management efficiency, accelerate communication between students and school staff, and support the creation of a more modern, interactive, and integrated learning environment.

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1. INTRODUCTION

The development of information technology has brought significant transformation to the field of education, particularly in enhancing efficiency, transparency, and accuracy in managing academic data (Kholifah et al., 2025). Digital systems have become a fundamental component of school management, enabling the integration of teaching processes, administration, and educational services (Rajes et al., 2024).

One of the main implementations is the student portal, a web- or mobile-based platform that provides real-time access to academic information such as grades, schedules, learning materials, and attendance (Buchori et al., 2024). This portal facilitates students, teachers, and parents through personal logins, dashboards, and notifications, allowing faster and more systematic monitoring and decision-making (Al Ma'ruf et al., 2025; Peni et al., 2024).

To improve attendance management, modern portals integrate QR barcode technology, a two-dimensional coding method readable via smartphone cameras (Willyansah, 2024). QR codes enable fast, cost-effective, and accurate digital attendance while minimizing the risk of data manipulation (Vitriani, 2023). Furthermore, geolocation integration through GPS and geofencing ensures the authenticity of attendance data, reduces fraud, and enables real-time monitoring (Fitri N, 2022; Purnomo, 2022; Saripuddin, 2022).

In addition, responsive mobile web interfaces allow access to the portal and QR-based attendance from any device, supporting mobile learning (m-learning) and flexible connectivity (Muhammad, 2022). The implementation of digital systems such as SIMANIS SISTE strengthens

school management by enhancing data handling, administrative workflows, transparency, and effective decision-making (Maikel, 2025).

Overall, the integration of student portals, QR codes, geolocation, and responsive mobile web creates a data-driven, transparent, and efficient digital education ecosystem, supporting comprehensive school management while improving the quality of learning and real-time student attendance monitoring. This study theoretically contributes to the conceptual development of the digital school ecosystem by demonstrating how the integration of academic data systems, location-based validation, and mobile accessibility collectively support educational transformation in Indonesia. It provides a framework that connects digital governance, transparency, and learning efficiency within the context of secondary education.

However, despite these advancements, several challenges remain unaddressed, particularly at the secondary school level. Limited digital infrastructure, unequal access to devices, lack of user literacy, and inconsistent data synchronization between platforms continue to hinder optimal implementation. These gaps highlight the need for further research to develop more inclusive, secure, and adaptive digital management systems for schools.

2. RESEARCH METHOD

This research aims to design and develop a web- and mobile-based student attendance portal utilizing QR barcode technology to enhance accuracy, efficiency, and transparency in attendance management (Fahlevi et al., 2022). The study addresses issues in manual attendance such as data manipulation, reporting delays, and lack of real-time access by proposing a QR-based system that allows students to scan upon arrival, automatically recording attendance accessible to teachers and administrators. Using the Research and Development (R&D) approach, the process includes system design, implementation, testing, and evaluation (Rafli, 2024). The system's functional requirements cover input (user data, schedules, attendance, and grades), processes (authentication, QR generation, scanning, and validation), and outputs (attendance reports and dashboards), while non-functional requirements focus on data security through encryption, fast response, and stability via caching. System reliability was tested using parameters such as attendance accuracy, data integrity, and user data security. The application is developed with Flutter for mobile, Next.js for web, Node.js with Express for backend operations, and PostgreSQL for database management secured by JWT authentication. Hardware requirements include a VPS server (minimum 2 GB RAM, SSD storage), smartphones with 5-megapixel cameras, and computers for teachers or admins with stable internet access. Integration of QR barcode and geolocation verification ensures real-time, accurate, and fraud-resistant attendance tracking, supporting data-driven administrative decisions. The conceptual design phase establishes a clear workflow and logical data structure through Flowchart, Use Case Diagram, Class Diagram, and Sequence Diagram, which collectively illustrate user authentication, data validation, and system verification to maintain data integrity and consistency.

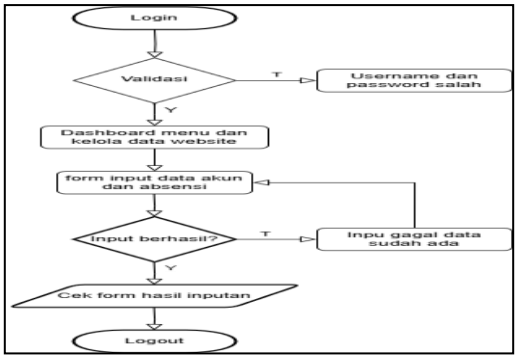

Figure 1. Flowchart

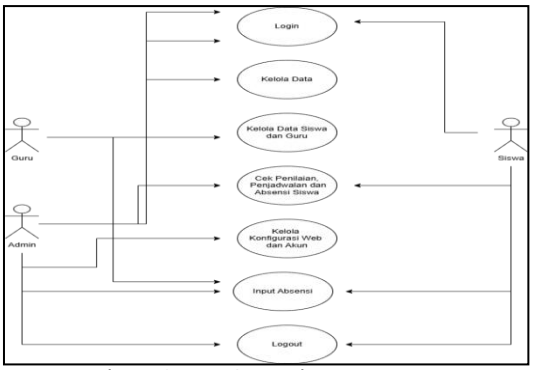

Figure 2. Use Case Diagram

The use case and class diagrams collectively provide a comprehensive understanding of the school data management system, illustrating both user interactions and the underlying object structure. The use case diagram defines the system's functional scope, enabling developers to grasp user requirements and design an appropriate interface and system logic. Meanwhile, the class diagram outlines the object-oriented structure and interrelationships, ensuring a modular,

organized, and maintainable system architecture that supports scalability and future enhancements.

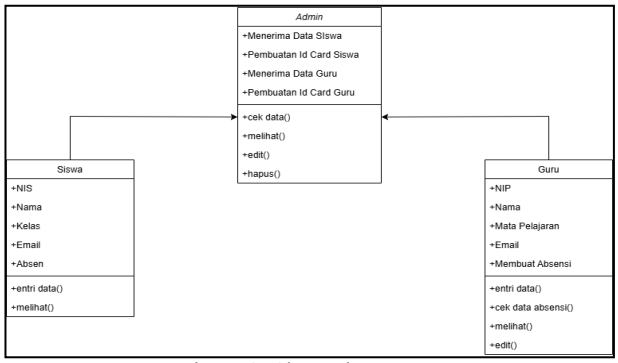

Figure 3. Class Diagram

A sequence diagram illustrates the chronological flow of interactions between objects within a system. It demonstrates how processes occur over time, starting from the user (actor) initiating an action to the system's corresponding response (Muhammad, 2024). In the context of a school management information system, the sequence diagram depicts the process flow from login to logout, as well as other key activities such as data management, attendance, and grading. The process begins when a user who may be an admin, teacher, or student enters their username and password. The system then validates these credentials and, if verified, directs the user to their respective dashboard based on access rights; otherwise, it displays a notification indicating a failed login attempt.

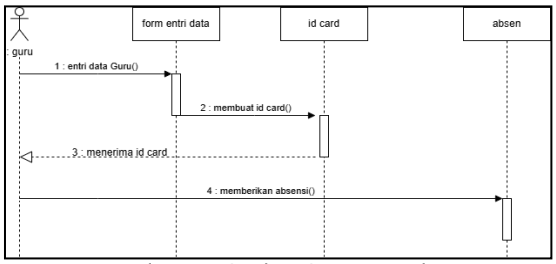

Figure 4. Student Sequence Diagram

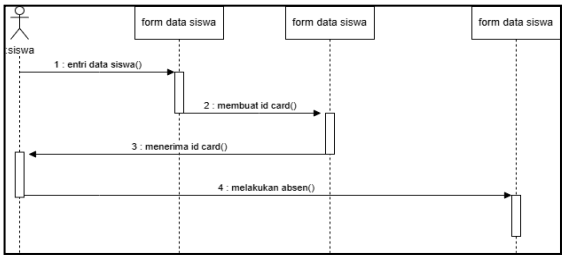

Figure 5. Teacher Sequence Diagram

The physical design phase illustrates the technical implementation of the system, focusing on the design of the user interface to ensure that the developed Student Portal operates efficiently and is user-friendly. The interface design (wireframe) provides a preliminary visualization of the application layout and element arrangement, aiming to create an intuitive, informative, and user-oriented interface (Ika, 2024). The Login Page serves as the initial access point for administrators, featuring input fields for email and password, a login button, and a "Login as Teacher" link to accommodate multi-role user access. The Admin Dashboard displays a left-side navigation menu containing core features such as Dashboard, User Management, Academics, and Schedule, enabling administrators to efficiently manage data and access essential information (Irfansyah et al., 2024). The Create Attendance Session Page allows teachers to schedule attendance sessions by selecting the date, class or subject, and duration, with two attendance recording options manual input or QR barcode scanning providing flexibility in managing attendance (Eknath et al., 2024). Upon selecting the QR method, the QR Barcode Attendance Page displays a unique QR code that students can scan to automatically record their presence, integrating modern technology to enhance accuracy and streamline the attendance process.

3. RESULTS AND DISCUSSIONS

The product developed in this Informatics Project is a web- and mobile-based district development planning management system designed for monitoring infrastructure and public facility projects. The system aims to provide both district officials and the community with an efficient and

transparent platform to oversee and manage development projects (Phirke et al., 2024). The application is built using modern programming languages and technologies, including Node.js (App Router) with API Routes, Prisma ORM, and PostgreSQL for the backend; Next.js and Tailwind CSS for a responsive and modern web frontend targeting administrators; and Flutter as a cross-platform framework for mobile access by students.

Discussion of Results

Web View

Below are displays of web applications used by admins and teachers:

Figure. 6 Homepage

The main page of the QR barcode-based digital attendance system at SMAN 1 Pabedilan serves as the system's homepage, introducing a modern attendance platform that emphasizes efficiency and technological integration within the school environment. It highlights key features such as real-time student attendance counts, daily attendance percentages, and QR code scanning for recording presence (Azmi et al., 2024). The page also displays statistics on the number of schools using the platform, total active students, and system accuracy as a validation of successful implementation.

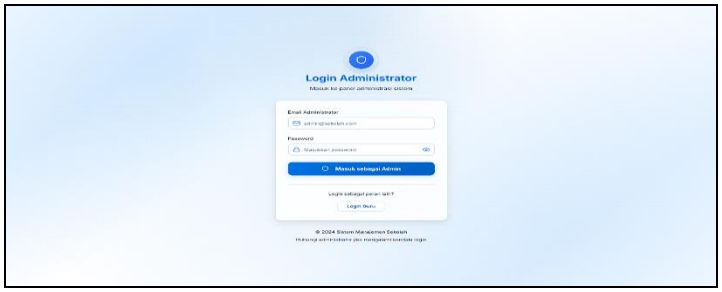

Figure 7. Admin login page

The admin login page of the mobile web-based school management system serves as an authentication gateway for users with administrative roles to access the system's control panel. Authentication is securely handled on the backend using JSON Web Tokens (JWT) to ensure session validity and high security. Upon successful authentication, users are redirected to the main dashboard according to their administrator access privileges.

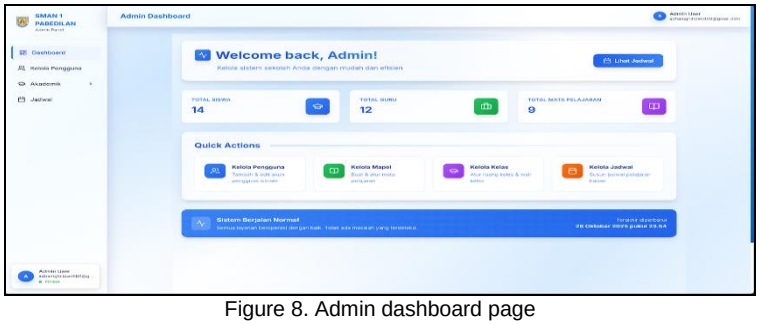

Figure 8. Admin dashboard page

The admin dashboard provides an overview of the school management system, displaying key data such as the number of students, teachers, active classes, and attendance percentages. It also features recent activities and upcoming agendas, enabling administrators to monitor and manage school operations efficiently. The interface is designed to be simple and informative, supporting quick and effective decision-making.

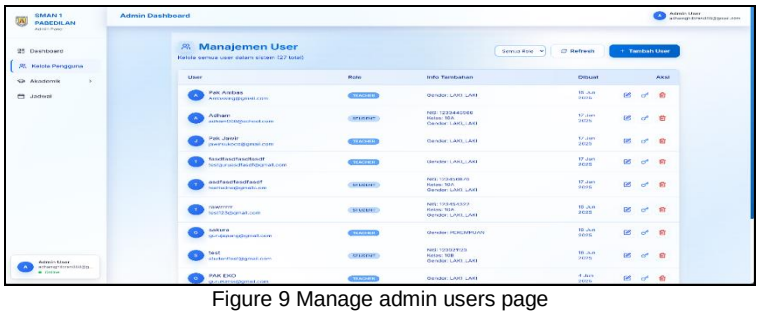

Figure 9 Manage admin users page

The User Management page in the school management information system allows administrators to view all registered users, including teachers, students, and staff, with key details such as email, username, role, and additional data like gender or ID number. It provides search and filter functions by role for efficient data retrieval, as well as action buttons to edit or delete user information directly (Herlina et al., 2023). The interface is designed to be simple yet functional, enabling administrators to monitor and manage user data efficiently and systematically.

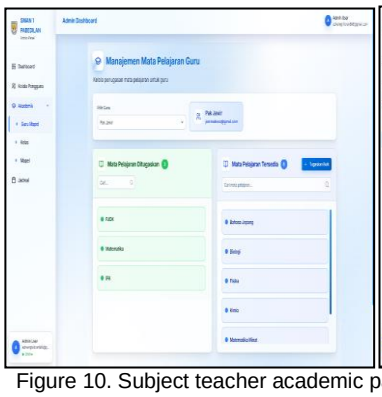

Figure 10. Subject teacher academic page

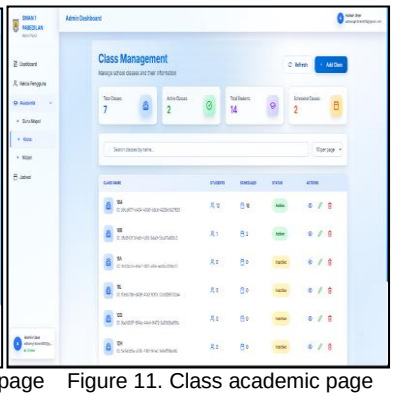

Figure 11. Class academic page

Figure 12. Academic subject page

The academic page on the admin dashboard serves to manage school academic data in an integrated manner. It allows administrators to organize subjects, assign or remove subjects for teachers, and monitor class information, including student numbers, schedules, and real-time class status (Sarjiyus et al., 2024). The subject menu also enables adding, editing, and deleting subjects taught at the school. Designed with a simple and user-friendly interface, this feature facilitates effective and efficient academic management.

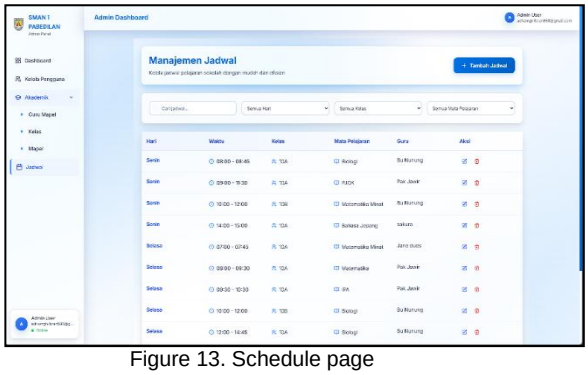

Figure 13. Schedule page

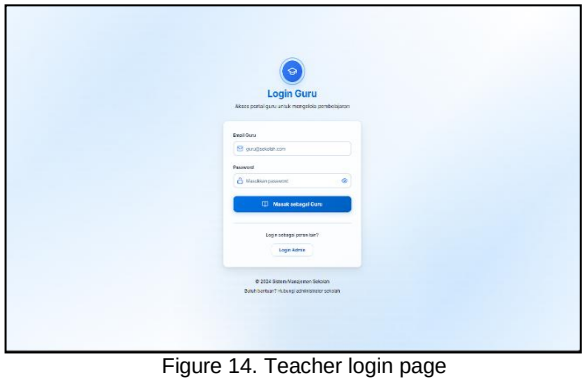

Figure 14. Teacher login page

The administrator dashboard in the school management system focuses on the Schedule Management feature, which allows structured management of class timetables. It displays information such as day, time, class, subject, and the assigned teacher. Administrators can easily add, edit, or delete schedules, and utilize search and filter options by day, class, or subject for efficient management (Taju et al., 2024). The interface is designed to be simple and informative, enabling administrators to monitor and organize class schedules effectively.

The teacher login page of the school management portal allows educators to access key features such as schedule management, student attendance tracking, grade entry, and learning reports. Designed with a simple and intuitive interface, the login page enables quick and efficient access, while also providing account memory and password recovery options to enhance user convenience.

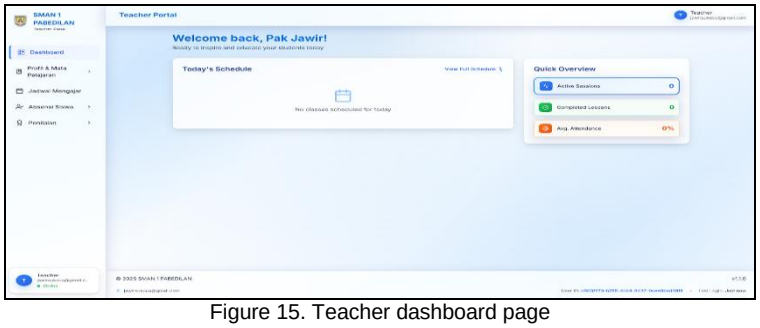

Figure 15. Teacher dashboard page

The teacher dashboard in the school management portal provides a concise overview of key information, including today's teaching schedule, ongoing sessions, completed lessons, and average student attendance rates (Tate & Misal, 2025). This real-time data helps teachers monitor learning activities efficiently, while the interface is designed to be simple, intuitive, and informative, enabling quick and effective access to educational data.

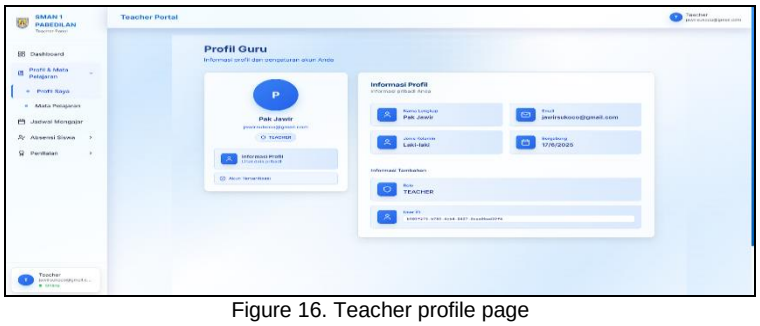

Figure 16. Teacher profile page

The teacher profile page displays essential information such as full name, email, gender, joining date, and user role within the system. Through this page, teachers can easily manage and update their personal data, ensuring data accuracy and supporting effective account management.

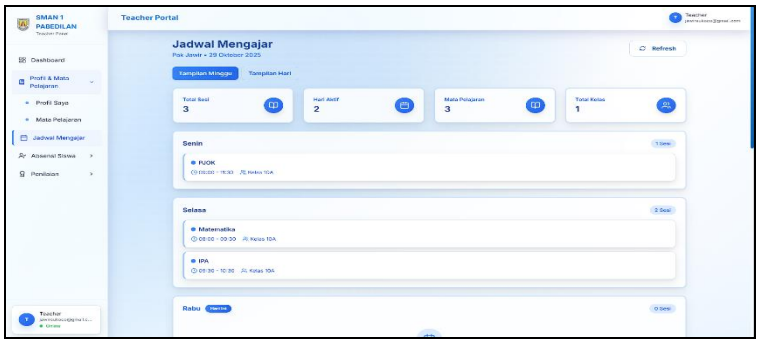

Figure 17. Teaching schedule page

The teaching schedule page provides a concise overview of key information, including total teaching sessions, active days, subjects taught, and the number of classes handled by each teacher. The schedule is organized by day, making it easier for teachers to monitor and manage their weekly teaching activities.

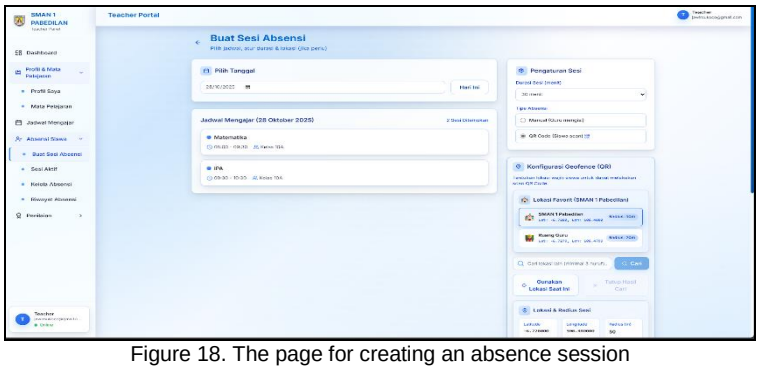

Figure 18. The page for creating an absence session

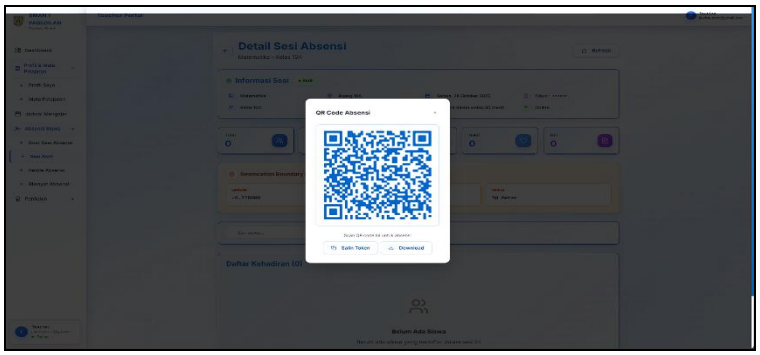

Figure 19. Active session page

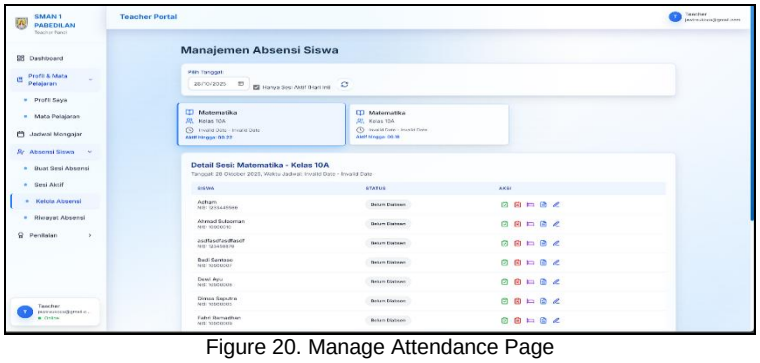

Figure 20. Manage Attendance Page

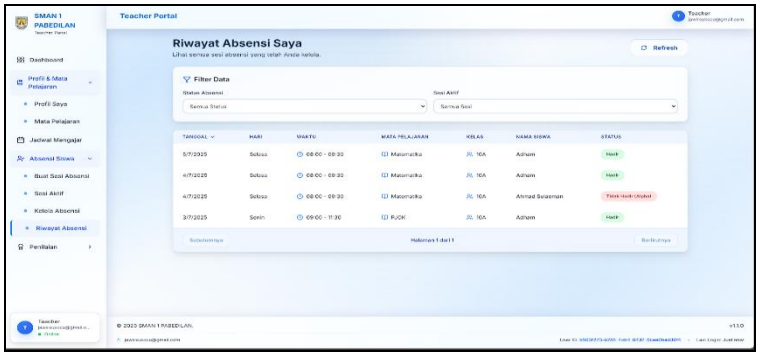

Figure 21. Attendance history page

The student attendance page helps teachers record and monitor student attendance digitally. Teachers can create attendance sessions based on the teaching schedule, specifying the date, duration, and method, either manually or via QR barcode. This feature is integrated with geolocation through a 500-meter geofencing radius around the school, validating QR scans to ensure only those within the designated area are accepted. By incorporating geolocation, the system enhances accuracy, efficiency, and prevents fraudulent attendance outside the school premises.

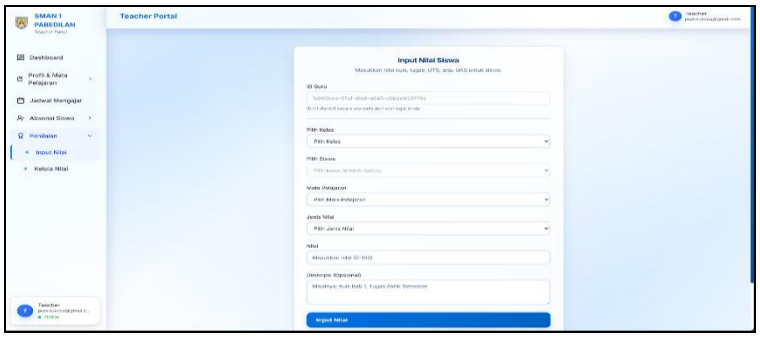

Figure 22. Student grade input page

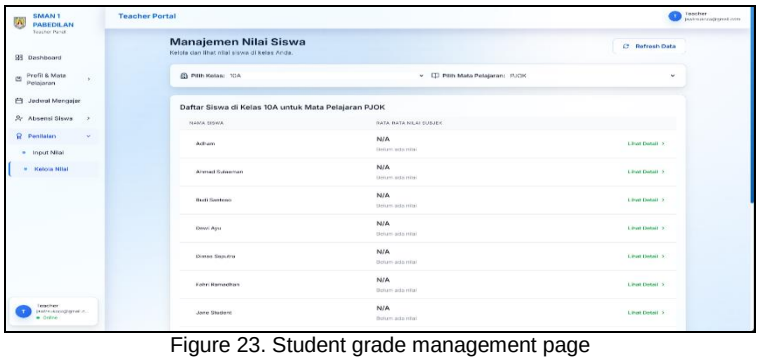

Figure 23. Student grade management page

The Student Assessment Page is a web-based school management system feature designed to simplify teachers' tasks in inputting, managing, and monitoring student grades. Teachers can enter various types of scores, such as assignments, midterms, and finals, by selecting the class, student, subject, and grade type. The feature also allows teachers to view detailed student performance and track academic progress through organized and informative data displays, supporting a structured and efficient evaluation process while systematically documenting student learning achievements.

Mobile view

Figure 24. Student login page

Figure 25. Student portal homepage

Figure 26. Class schedule page

As shown in Figures 24, 25, and 26, the student portal system features a structured and user-friendly interface designed for accessibility and efficiency. The login page (Figure 19) acts as the

main entry point, requiring a registered email and password to ensure secure access for verified users. After logging in, students are directed to the main dashboard (Figure 20), which displays key academic information such as name, school email, student ID (NIS), class, today's schedule, and a summary of recent grades within a responsive and organized layout. The timetable page (Figure 21) presents daily schedules, including subject names, instructors, and class times, helping students manage their study activities more effectively through a clean, intuitive, and day-based interface design.

Figure 26. QR barcode scan page

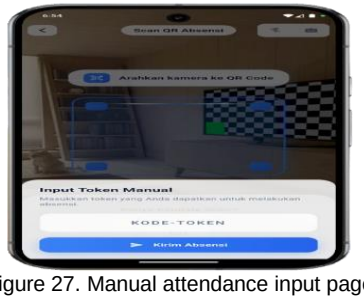

Figure 27. Manual attendance input page

As shown in Figure 26, the QR barcode scanning page allows students to record attendance by pointing their device camera at the school's QR code, ensuring efficient, real-time, and fraud-resistant validation. Figure 27 shows the manual attendance input page, where students can enter a token code as an alternative when the QR scanner is unavailable, such as during camera errors or poor lighting.

Figure 28 Value list page

Figure 29. Student profile page

Figure 30. Attendance history page

Figures 28–30 illustrate key features of the student portal, including the Grade List, Student Profile, and Attendance History pages. The Grade List Page displays students' scores categorized by assessment types such as midterms and finals, and automatically notifies them when grades have not yet been entered, promoting transparency and self-assessment. The Student Profile Page provides structured personal information such as full name, email, student ID (NIS), class, gender, and attendance statistics through a clean, responsive card-based layout optimized for mobile use(Karnita et al., 2025). Meanwhile, the Attendance History Page allows students to review their attendance status (Present, Excused, Sick) using a filter feature for precise data retrieval, with a "no data" message displayed when records are unavailable. Collectively, these pages support centralized, real-time academic monitoring and enhance user experience through intuitive and organized interface design.

Figure 31. Attendance statistics page

The attendance statistics page provides a summary of student attendance in percentage form, including attendance rates, number of sessions, and subject-wise attendance charts. If no attendance data is available, the system displays a notification indicating that records are not yet available. This page is designed to offer an overview of student participation in learning activities, supporting the quantitative evaluation of discipline. The implementation of this digital system also implies a transformation in the roles of teachers and administrative staff, where teachers shift from manual data handling to supervisory and analytical roles, while administrative staff focus more on data validation, monitoring, and system-based reporting rather than routine paperwork.

4. CONCLUSION

Based on the design and implementation of the web-mobile Student Portal with QR Barcode and geolocation integration, the system effectively addresses manual attendance issues while enhancing the validity of attendance data through location verification. With a 500-meter geofencing radius, QR scans can only be performed within designated areas, minimizing fraud and ensuring data accuracy. Testing shows that the geolocation feature works reliably under various network conditions, providing notifications if users attempt to check in outside the permitted area. The use of Next.js for the web and Flutter for mobile supports a responsive, cross-platform system, allowing teachers to monitor attendance, manage schedules, and input grades, while students can access schedules, view grades, and mark attendance easily. Overall, the prototype demonstrates improved operational efficiency, accurate data collection, and positive user experience, although limitations remain, including the lack of a native mobile app, absence of assignment management, and reliance solely on QR codes without biometric or RFID authentication. Practically, this research can guide education policymakers in accelerating school digitization by adopting standardized QR- and geolocation-based attendance systems that ensure transparency, accountability, and real-time monitoring across institutions. These limitations offer opportunities for further development, such as adding biometric authentication, parent notifications, and LMS integration, indicating the system's potential as a modern, adaptive digital school solution. Future enhancements could realistically include integrating cloud-based analytics dashboards, implementing multi-language support, and developing an offline attendance mode to improve accessibility in remote areas.

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