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DEVELOPMENT AND EVALUATION OF A CROSS-SUBJECT ATTENDANCE PATTERN SYSTEM

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ABSTRACT

Student attendance is crucial for academic success and compliance with institutional policies, such as the 80% attendance rule for exam eligibility. However, existing systems often operate in subject silos, making it difficult to identify students whose absenteeism spans multiple courses. This study aimed to develop and evaluate the Cross-Subject Student Attendance Pattern (CSSAP) system, a web-based platform designed to consolidate attendance data across subjects, facilitate collaboration among lecturers, and support timely intervention for at-risk students. The platform was built using PHP for server-side logic and MySQL for database management, creating a dynamic web application accessible through standard browsers. A field test was conducted with 36 participants (30 students, 6 lecturers) to evaluate usability, functionality, and user acceptance via a Likert-scale questionnaire and open-ended feedback. The evaluation revealed strong positive feedback across all measured dimensions. CSSAP addresses a critical gap in academic administration by providing a centralised, collaborative tool for attendance monitoring. Effective monitoring is conceptualised as a three-stage process: recording (initial data collection), reporting (sharing data with stakeholders), and using the data to inform decisions and interventions. The system empowers lecturers to make data-driven, fair decisions regarding student barring and enables early intervention. The CSSAP system serves as a model for other institutions seeking to modernise attendance management and enhance student support mechanisms through accessible web-based solutions.

Keywords: attendance monitoring, academic barring, web-based system, student engagement, higher education administration

INTRODUCTION

Student attendance is a widely recognised indicator of academic engagement and a strong predictor of success in higher education (Ancheta et al., 2021). Institutions often implement strict attendance policies, such as requiring 80% attendance for examination eligibility, to encourage discipline and ensure a minimum level of participation. At Universiti Utara Malaysia (UUM) and other public institutions of higher learning (IHLs), effectively enforcing this policy is an administrative challenge. The primary issue

lies not in recording attendance but in synthesising it across a student's entire course load. Lecturers typically manage attendance records per subject, creating data silos that obscure broader patterns of disengagement (Siew et al., 2023). A student may marginally meet the threshold in individual subjects but exhibit a concerning pattern of absenteeism across all enrolled courses, a risk that remains invisible in fragmented systems. This fragmented view prevents the early identification of disengagement, which is critical because attendance is increasingly recognised as a leading indicator of student success (Bergin & Ferrara, 2019).

Current solutions for attendance records range from manual registers to digital tools such as biometric systems and QR code scanners (Garg, 2024). While these improve recording efficiency, they fail to facilitate cross-subject analysis or lecturer collaboration. This lack of a holistic view can lead to inconsistent and potentially unfair barring decisions, as lecturers lack the complete context of a student's overall engagement (Renaldo et al., 2021). Furthermore, the inability to identify at-risk students early prevents the provision of proactive academic support, undermining the policy's remedial intent.

To bridge this gap, the Cross-Subject Student Attendance Pattern (CSSAP) system was developed. CSSAP is a dedicated web-based platform that aggregates attendance data from multiple subjects into a centralised database. Its core innovation is a unified dashboard that lets lecturers and administrators view cumulative attendance percentages, receive automated alerts when students fall below the threshold, and share contextual comments. This study details the development and evaluation of CSSAP. It examines how a centralised, collaborative digital platform can transform attendance monitoring from a reactive, subject-specific task into a proactive, student-centric support mechanism, thereby promoting fairer academic governance and timely intervention.

The CSSAP system offers several significant contributions to academic attendance management. First, it enhances academic transparency by providing a centralised platform for lecturers and administrators to share and monitor student attendance patterns across subjects, enabling early identification of at-risk students and timely interventions. Second, it promotes fairer academic governance by ensuring that all relevant data about a student's attendance behaviour across all enrolled courses is considered when making barring decisions, rather than assessing absenteeism in isolation within individual subjects. Third, the system supports lecturers by streamlining attendance tracking and facilitating collaboration with colleagues, moving from independent record-keeping to coordinated intervention strategies. Finally, administrators gain greater visibility and control over attendance data, enabling them to monitor academic policies more effectively and allocate support resources where needed.

By providing tools to monitor student attendance patterns across multiple subjects, CSSAP ensures that students receive necessary academic support before facing academic penalties, ultimately improving academic performance through early intervention and informed decision-making.

The remainder of this paper is organised as follows. Section 2 reviews prior work on attendance monitoring systems and identifies the research gap this study addresses. Section 3 discusses the significance of the project. Section 4 describes the research methodology, including the Agile development approach and system design. Section 5 presents the findings from the system implementation and usability evaluation. Finally, Section 6 concludes the paper with a summary of contributions, limitations, and directions for future work.

LITERATURE REVIEW

Over the years, several systems and technical solutions have been developed to help institutions manage and monitor student attendance. This section reviews existing attendance monitoring systems, compares their features and limitations, and identifies the research gap that the CSSAP system addresses.

The traditional method of manual attendance-taking involves paper-based registers or roll calls, which are time-consuming and error-prone (Garg, 2024). These methods lack proper data consolidation, making it difficult for lecturers to track student attendance patterns across multiple subjects. With advancements in technology, many institutions have embraced automated attendance systems, including biometric systems (fingerprint or face recognition) and QR code scanning tools (Siew et al., 2023). While these technologies have improved recording efficiency, they primarily focus on data capture rather than on data analysis and cross-subject integration.

Table 1 presents a comparative analysis of existing attendance monitoring systems based on key features identified from the literature.

Table 1

Comparative Analysis of Existing Attendance Monitoring Systems

Feature / System	Manual Register	Biometric System	QR Code System	Existing Web-Based System	CSSAP (Proposed)
Digital attendance recording	No	Yes	Yes	Yes	Yes
Cross-subject attendance view	No	No	No	No	Yes
Automated alerts for at-risk students	No	No	No	Rare	Yes
Lecturer collaboration tools	No	No	No	No	Yes
Intervention tracking module	No	No	No	No	Yes
Real-time attendance visualisation	No	Limited	Limited	Yes	Yes
Exportable reports	No	Sometimes	Sometimes	Yes	Yes

As shown in Table 1, existing systems operate independently within individual courses, with each lecturer maintaining separate attendance records. Biometric and QR code systems (Renaldo et al., 2021) improve efficiency but fail to address data sharing and lecturer collaboration. Most critically, current systems lack automated tools to detect attendance patterns across multiple subjects or to enable communication among faculty members regarding at-risk students.

The necessary functionality for collaborative decision-making, especially when evaluating students' absenteeism patterns across multiple subjects, is absent in existing attendance systems. This fragmented approach leads to inefficiencies, as lecturers cannot access a complete view of a student's attendance

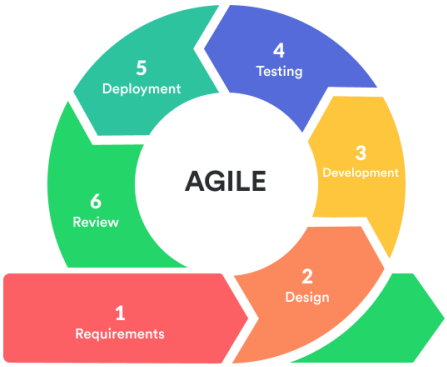
behaviour across their entire course load. Without a consolidated platform, students may fall through the cracks, and important opportunities for academic support or intervention may be missed. The CSSAP system addresses this gap by enabling lecturers and administrators to share and access comprehensive attendance data in real-time across subjects.

METHODOLOGY

The development of the CSSAP system followed the Agile methodology, chosen for its iterative and user-centric approach that supports incremental delivery and continuous feedback (Beck et al., 2001; Chathmini, 2021). Agile development emphasises regular assessment, adaptation to emerging requirements, and close collaboration with stakeholders (Martin, 2002). As illustrated in Figure 1, the project progressed through six sequential phases: Requirements, Design, Development, Testing, Deployment, and Review. This cyclical structure enabled regular assessment and refinement, ensuring the final product was closely aligned with stakeholder needs. Each phase produced specific deliverables that were reviewed before proceeding, thereby reducing project risks and enhancing overall system quality.

Figure 1

Phases involved in developing CSSAP



Requirements Phase

During this initial phase, project objectives and functional needs were gathered through consultations with lecturers and administrators at Universiti Utara Malaysia (UUM). The core problem – lack of a centralised platform for monitoring attendance across subjects – was analysed, and key requirements were documented. These included role-based access for lecturers and administrators, secure login, attendance entry per subject, calculation of cumulative attendance, cross-subject viewing, automated alerts for attendance below 80%, and a lecturer comment module. A product backlog was created, prioritising features based on stakeholder value. The technology stack was confirmed as PHP for server-side logic and MySQL for the relational database, ensuring compatibility with the university's existing infrastructure.

Design Phase

In the design phase, system architecture and user experience were planned. A MySQL database schema was designed to efficiently store data for users, students, courses, attendance sessions, and comments. Entity-relationship diagrams were created to define relationships among tables. Simultaneously, user interface prototypes were developed using wireframing tools, outlining key screens such as the login page, lecturer dashboard, attendance entry form, and cross-subject view. The design emphasised clarity, using visual indicators (colour codes, progress bars, graphs) to highlight at-risk students. Security measures,

including session-based authentication and SQL injection prevention, were also incorporated into the design specifications.

Development Phase

This phase involved the actual coding of the system based on approved designs. PHP scripts were written to handle user authentication, session management, form processing, and business logic. The frontend was built with HTML, CSS, and JavaScript to create responsive and interactive web pages. MySQL queries were embedded within PHP to perform CRUD operations, including creating attendance records, reading cumulative attendance data, updating student status, and generating alert flags. Key modules developed included the role-based login system, the lecturer dashboard displaying student lists with attendance percentages, the cross-subject attendance viewer (using SQL JOINs), and the automated alert module that triggers when attendance falls below 80%. The system was developed and tested incrementally within a local Apache server environment (XAMPP).

Testing Phase

Rigorous testing was conducted to ensure functionality, usability, and reliability. Unit testing verified individual components, including login authentication, attendance calculation algorithms, and alert logic. Integration testing ensured that modules worked together seamlessly – for example, that entering attendance updated both the database and the dashboard in real time. User Acceptance Testing (UAT) was conducted with a group of lecturers and students, who were asked to perform typical tasks such as logging in, marking attendance, viewing cross-subject data, and responding to alerts. All feedback from UAT was documented for analysis. (Note: The results of this testing are presented in Section 5 – Findings and Discussions.

Deployment Phase

After successful testing, the CSSAP system was deployed to a live web server. All PHP files, MySQL database scripts, and assets (CSS, JavaScript, images) were uploaded to a hosting environment that supports PHP/MySQL. Configuration settings were adjusted for the production server, including database connection parameters and security rules. User accounts were created for initial lecturers and administrators, and the system was made accessible via a dedicated URL. A user manual and administrative guide were also prepared to support onboarding and daily operation.

Review Phase

The final phase involved post-deployment monitoring and collection of user feedback through surveys and direct interviews. This feedback was systematically recorded to identify system strengths and areas for future enhancement. The review phase confirmed that CSSAP met its primary objectives and provided a foundation for planned future upgrades.

FINDINGS AND DISCUSSIONS

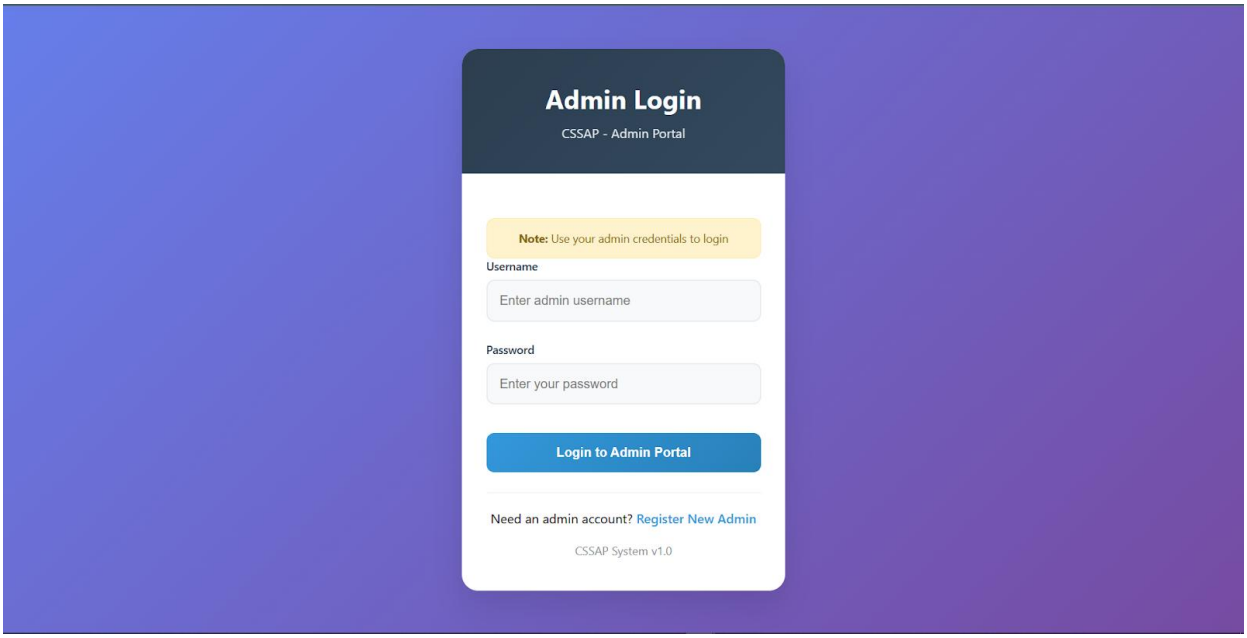
After finalising the system design, the CSSAP web application was developed using PHP and MySQL. The application features a clean, institutional-style interface with distinct portals for administrators and lecturers, each designed to simplify their specific workflows. The user interface was implemented with a responsive layout, ensuring accessibility across desktop and tablet devices.

Administrative Interface

For system administrators, CSSAP provides a comprehensive portal for managing all aspects of the attendance monitoring ecosystem. Figure 2 shows the Admin Login Page, which features a distinct design from the lecturer portal and requires specific administrator credentials for access, ensuring secure separation of roles.

Figure 2

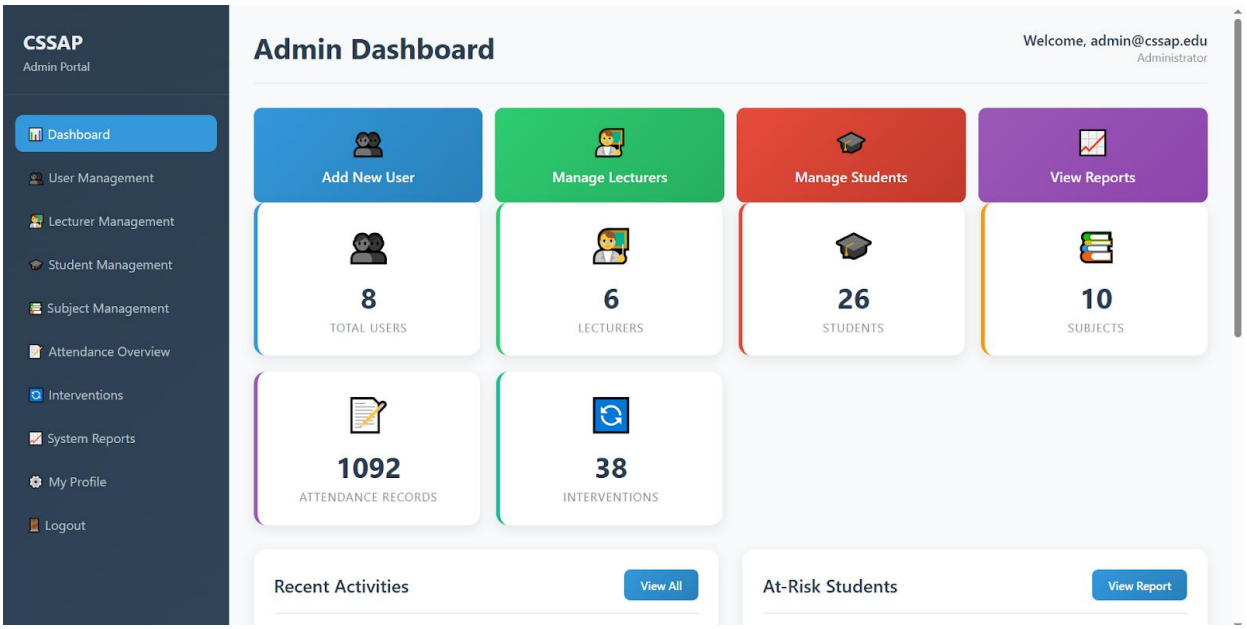
Admin Login Page



Upon successful authentication, administrators are directed to the Admin Dashboard (Figure 3 (a)). This central hub displays key system metrics: Total Users (8), Lecturers (6), Students (26), and Subjects (10). Quick-access cards for Add New User, Manage Lecturers, Manage Students, and View Reports provide efficient navigation to core management functions. A Recent Activities panel offers a real-time log of system events, supporting administrative oversight.

Figure 3

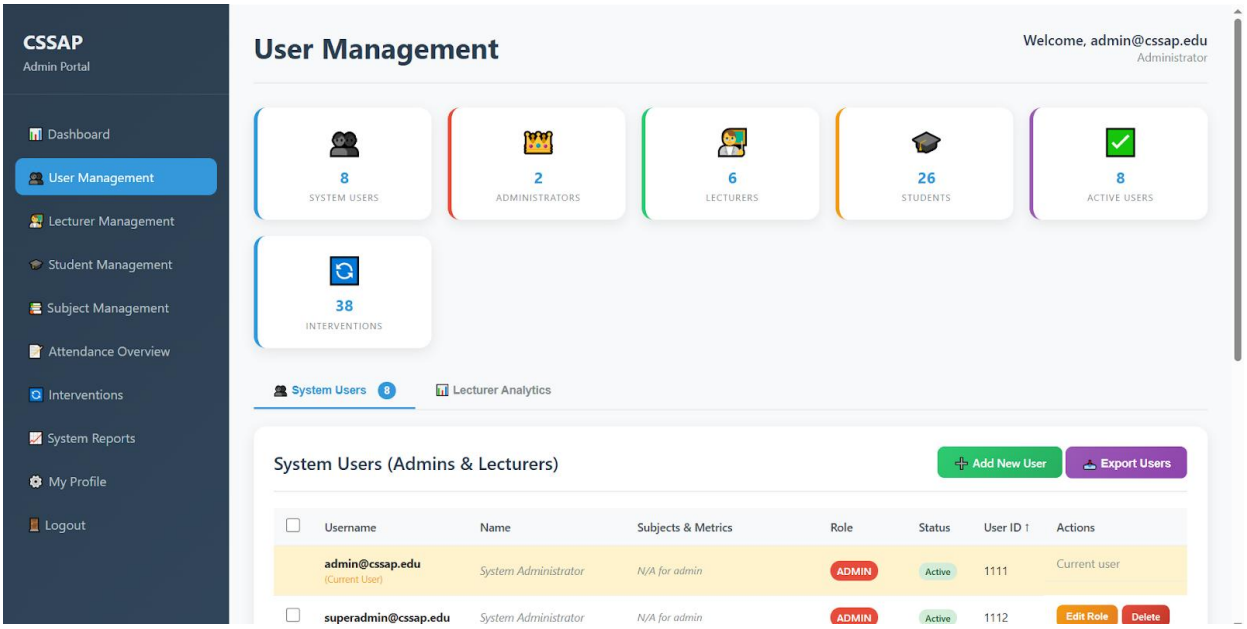
Admin Dashboard



The User Management module (Figure 4) allows administrators to oversee all system users (both administrators and lecturers). The interface lists each user with details including username, name, assigned role, status, and unique user ID. Administrators can edit roles or delete accounts as needed, with clear safeguards to prevent modification of the currently logged-in user.

Figure 4

User Management Page

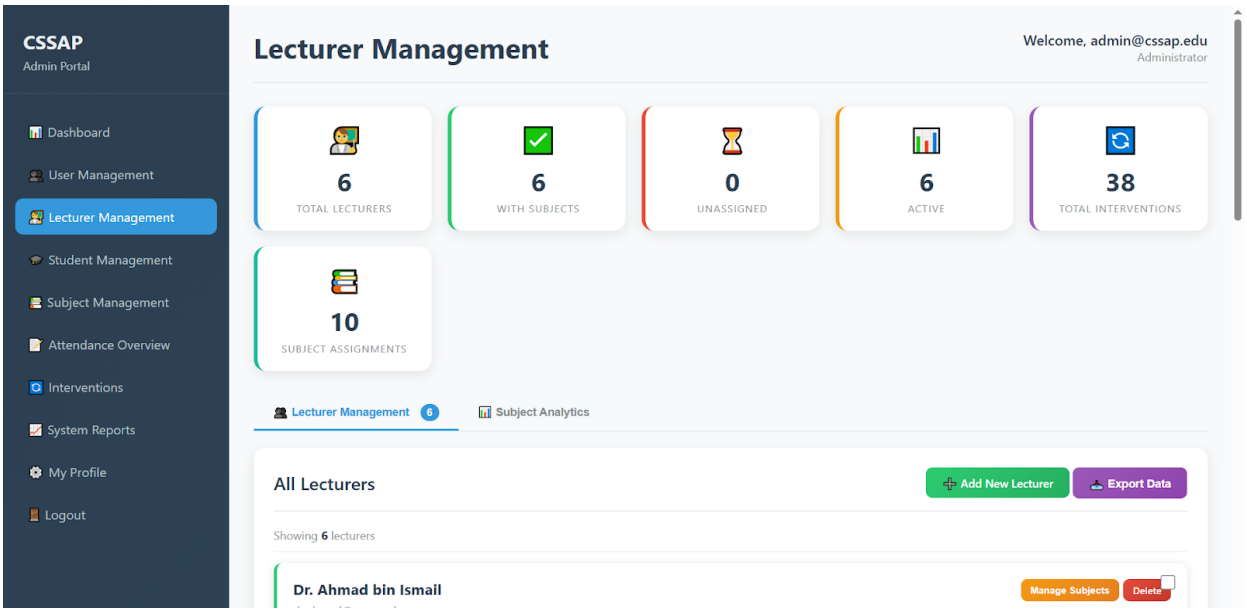


Lecturer Management (Figure 5) provides detailed analytics view alongside a list of all lecturers. Summary cards display metrics such as Total Lecturers (6), Active (6), Total Interventions (38), and Subject

Assignments (10). Administrators can view, assign subjects to, or manage individual lecturers' accounts from this centralised panel.

Figure 5

Lecturer Management Page

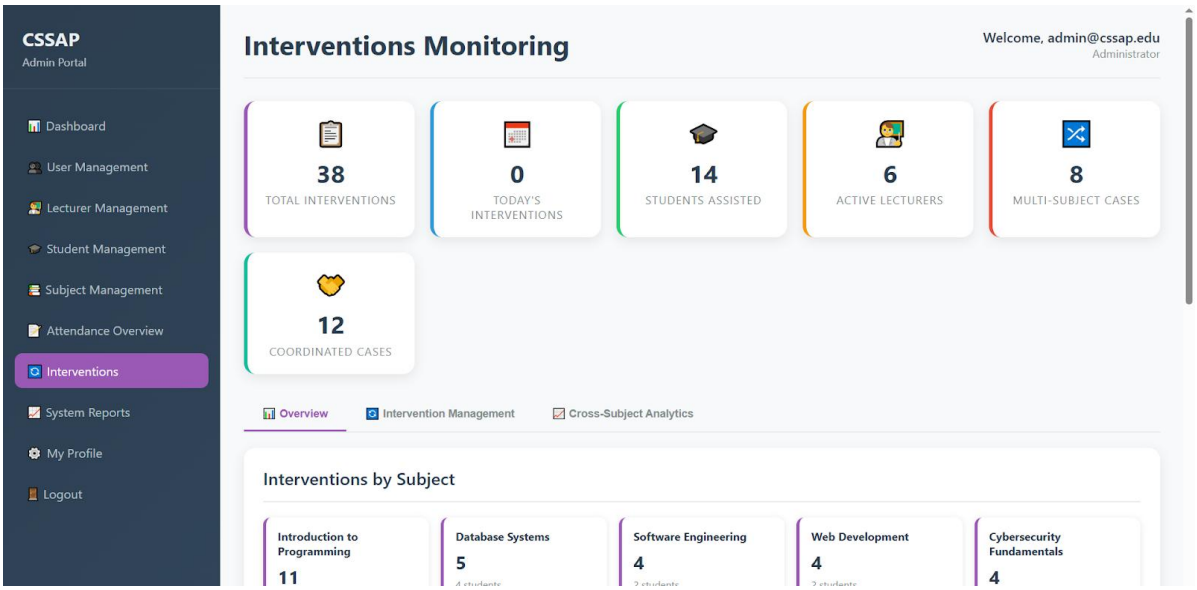


Comprehensive attendance oversight is available through the Attendance Management page. Administrators can view aggregate statistics (Total Records: 1092, Present: 858, Absent: 234) and use advanced filters (by date, student, subject, lecturer, or status) to search through all attendance records in the system. This allows for auditing, correction, and high-level trend analysis across the entire institution.

The Interventions Monitoring dashboard (Figure 6) provides administrators with a high-level view of student support activities. Key metrics include Total Interventions (38), Students Assisted (14), and Multi-Subject Cases (8). A visual breakdown of Interventions by Subject helps identify which courses require the most academic support, facilitating resource allocation and policy review.

Figure 6

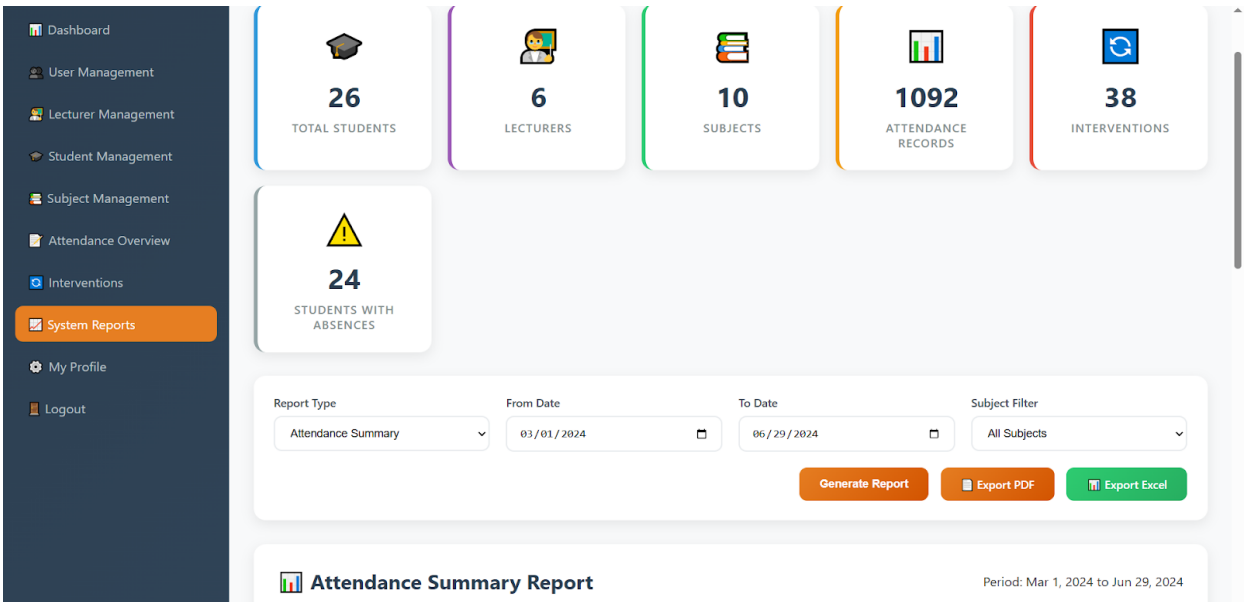
Interventions Monitoring Dashboard



For institutional reporting, the System Reports module (Figure 7) enables the generation of formal reports. Administrators can configure an Attendance Summary Report by selecting a date range and a subject filter. The system compiles the data, which can then be exported in PDF or Excel format for official records, meetings, or compliance purposes.

Figure 7

System Reports Page with Export Options



Finally, administrators manage their accounts via the My Profile page, which mirrors the functionality of the lecturer profile but includes administrator-specific summary statistics (System Users, Attendance Records, Interventions, Total Records). The Edit Profile Information section allows updates to username,

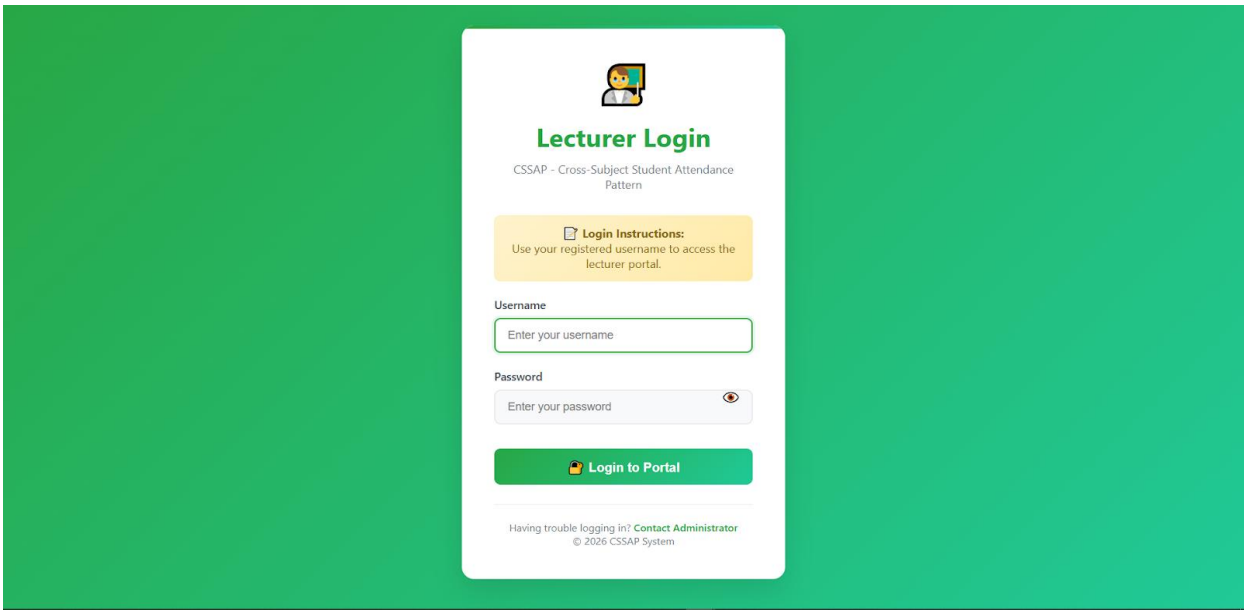
name, email, and password, maintaining security through current password verification for sensitive changes.

Lecturer Interface

Upon accessing the system, lecturers are presented with a secure login page. Figure 8 shows the Lecturer Login Page, which requires a username and password. The page includes clear instructions and a contact option for administrator support, emphasising security and ease of access.

Figure 8

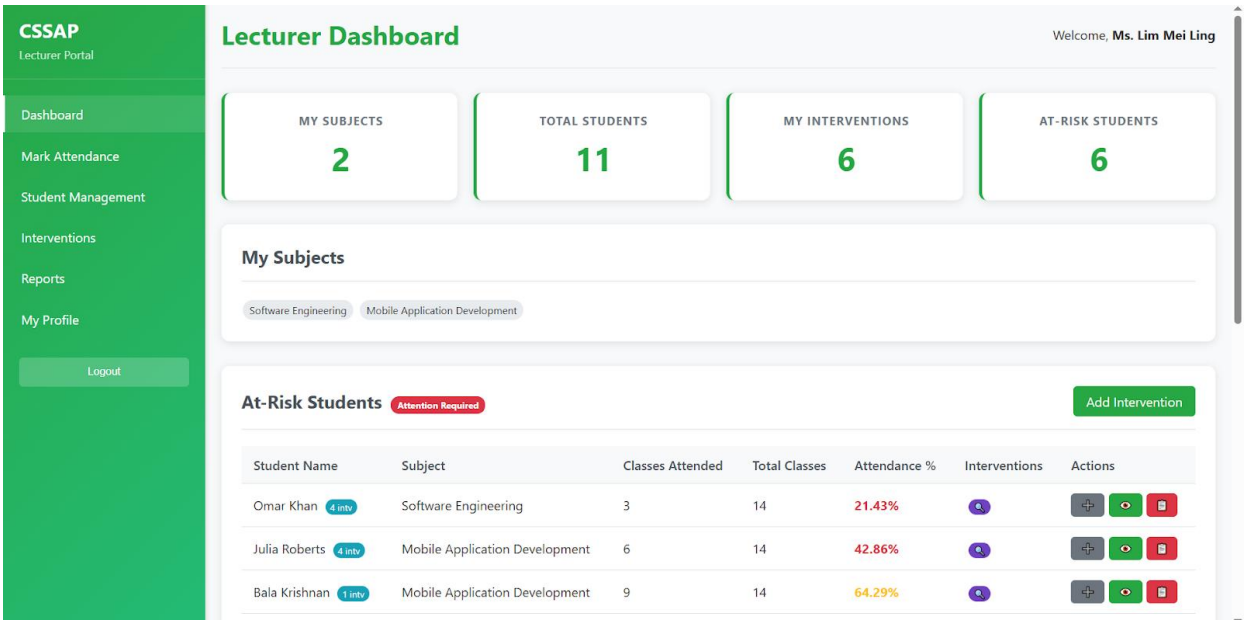
Lecturer Login Page



Once authenticated, lecturers are directed to the main Dashboard. Figure 9 (a) displays the Lecturer Dashboard, which provides a comprehensive overview of teaching responsibilities and student status. Key metrics are displayed at the top: My Subjects (2), Total Students (11), My Interventions (6), and At-Risk Students (6). The dashboard lists the lecturer's subjects and a detailed table of at-risk students, showing each student’s name, subject, classes attended, total classes, attendance percentage, and options to view or add interventions. This centralised view allows lecturers to quickly identify students who fall below the 80% attendance threshold.

Figure 9

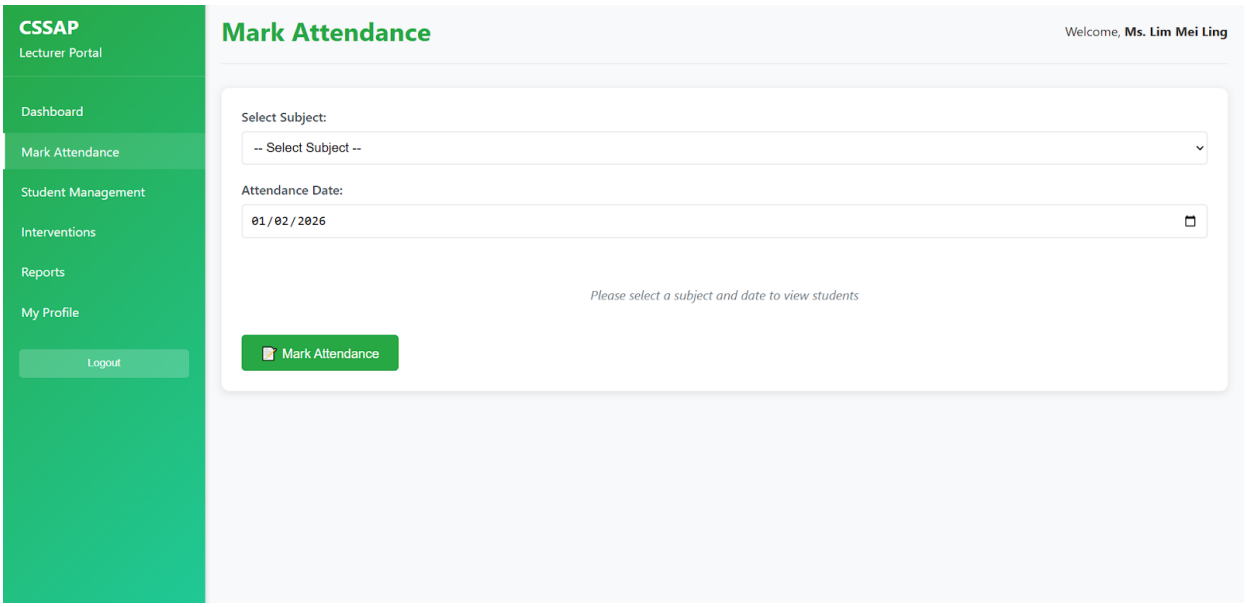
Lecturer Dashboard



The Mark Attendance module, shown in Figure 10, allows lecturers to record daily attendance. Lecturers select a subject and date from the dropdown and date picker controls. The interface is streamlined for efficiency, minimising the steps required to submit attendance data for a class session.

Figure 10

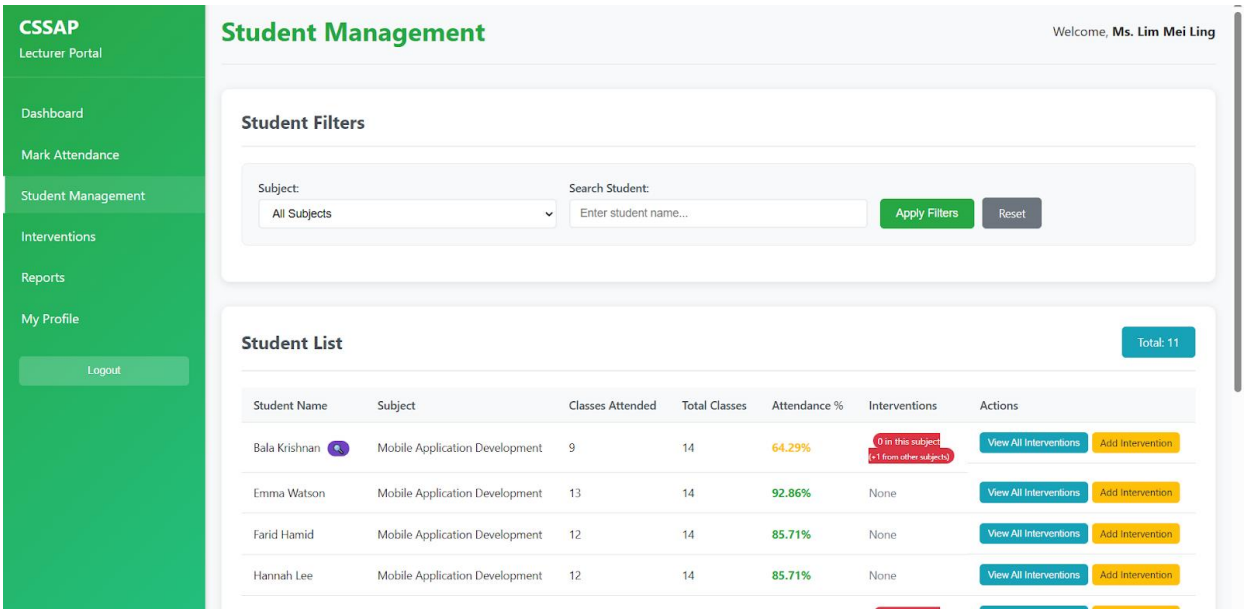
Mark Attendance Page



For detailed student oversight, the Student Management page (Figure 11) offers advanced filtering and a complete list of students. Lecturers can filter students by subject or search by name. The table displays each student's attendance metrics and a history of interventions. Action buttons ("View All Interventions", "Add Intervention") enable direct follow-up, facilitating proactive student support.

Figure 11

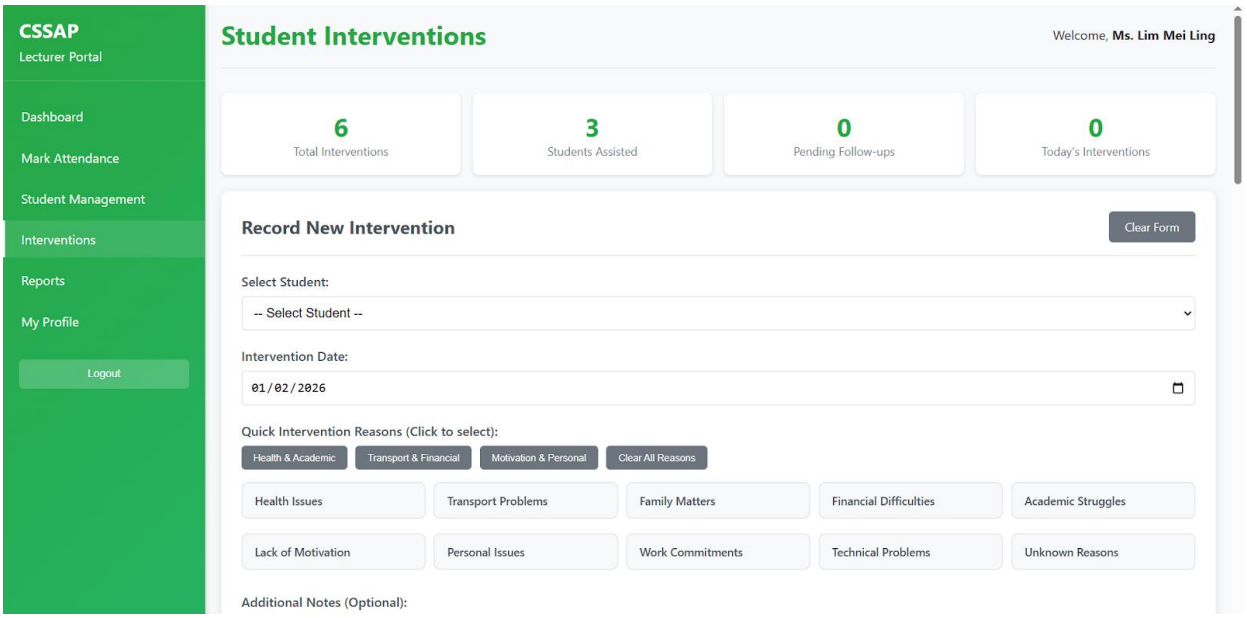
Student Management Page



The Interventions module, illustrated in Figure 12, supports the documentation of student support actions. The Record New Intervention section allows lecturers to select a student, set a date, and choose from predefined intervention reasons such as Health Issues, Academic Struggles, or Transport Problems, or add custom notes. This standardised logging system ensures consistent record-keeping and helps track student engagement over time.

Figure 12

Record New Intervention Page



Lecturers can generate analytical reports through the Reports module, which includes:

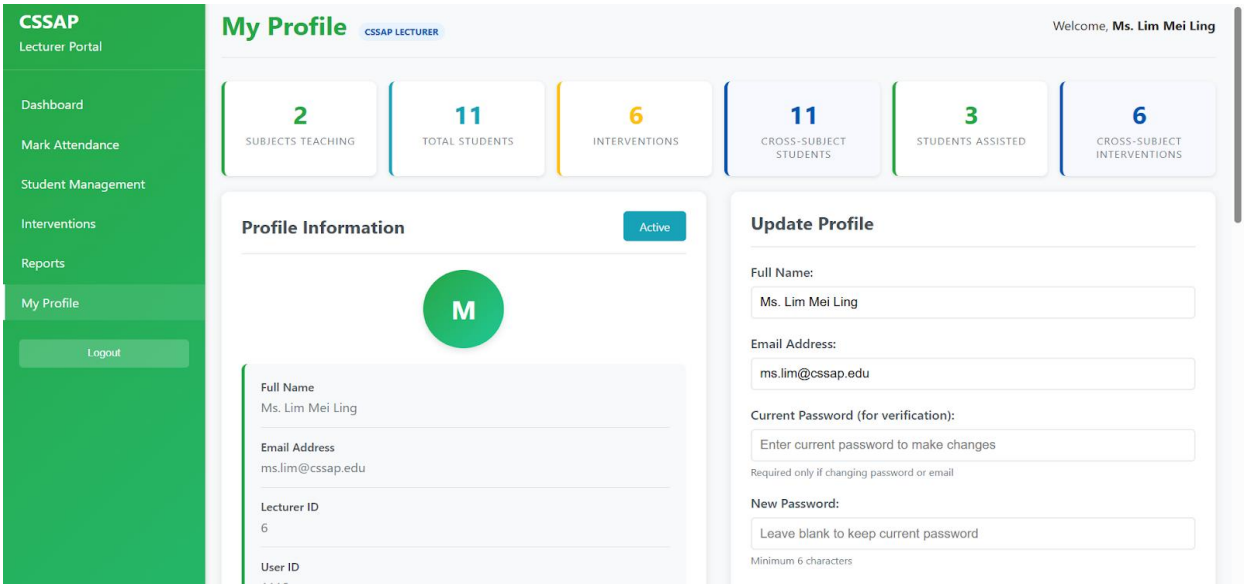
1. Risk Distribution Overview: A visual chart showing the proportion of students in different risk categories.
2. Cross-Subject At-Risk Analysis: A table identifying students who are at-risk across multiple subjects, highlighting patterns of broad disengagement.

3. Detailed Attendance Report: A comprehensive exportable list of all attendance records, filterable by date range, subject, or student.

Finally, the My Profile page (Figure 13) allows lecturers to view and manage their accounts. The profile header displays summary statistics, including Subjects Teaching (2), Total Students (11), and Cross-Subject Interventions (6). The Profile Information section shows personal details and account status, while the Update Profile form enables changes to name, email, and password, with security verification for sensitive updates.

Figure 13

My Profile Page



System Implementation and Architecture

Administrative control and system management for CSSAP are conducted through a dedicated admin panel built with PHP and a MySQL database. Administrators can manage lecturer and student accounts, review all attendance entries, monitor intervention logs, and generate institutional reports directly from the database. While this backend approach provides effective oversight, future development could include a more integrated, real-time administrative dashboard within the main application interface.

Usability Evaluation

A usability evaluation was conducted with 36 respondents to gather feedback and suggestions on the CSSAP system. User testing was conducted by providing respondents with access to the web application and asking them to explore its features. After testing, they were required to complete a questionnaire via Google Forms. The questionnaire was self-developed based on the System Usability Scale (SUS) framework (Brooke, 1996), which is a widely validated instrument for evaluating system usability across

five dimensions: ease of use, interface clarity, functionality, learnability, and user satisfaction. Additional items specific to attendance-monitoring features, such as cross-subject viewing, automated alerts, and intervention tracking, were adapted from prior studies on educational technology acceptance (Davis, 1989; Ancheta et.al., 2021). The questionnaire consisted of 15 closed-ended Likert-scale items and 3 open-ended questions for qualitative feedback. Two experts in educational technology reviewed all items to ensure content validity before distribution. The responses were then analysed, and the results were presented in charts and tables for clearer interpretation.

Section A: Demographic

This section shows the background of the respondents. The study included 36 participants, divided into two groups: 30 students and 6 lecturers. No administrators participated in the evaluation. The majority of participants identified as female (72.2%), and most were aged 21 to 25 years (90.0%). In terms of academic level, a large majority (83.3%) held a bachelor's degree. Among lecturer respondents, 65.5% had more than 10 years of experience in higher education, lending weight to their practical insights.

Table 2

Demographic profile of respondents (N = 36)

Demographic Variable	Category	Frequency	Percentage (%)
Role	Student	30	83.3
	Lecturer	6	16.7
Gender	Male	10	27.8
	Female	26	72.2
Age (Student only, n=30)	16-20 years	2	6.7
	21-25 years	27	90.0
	26-35 years	1	3.3
Age(Lecturers only, n=6)	26-35 years	1	16.7
	36-45 years	3	50.0
	46- 55 years	2	33.3
Highest Education Level	Diploma	1	2.8
	Bachelor's Degree	30	83.3
	Master's Degree	3	8.3
	PhD	2	5.6
Years of Experience in Higher Education (Lecturers only, n=6)	Less than 3 years	0	0
	3–5 years	1	16.7
	6–10 years	1	16.7
	More than 10 years	4	66.6

Note: Years of experience data were collected only from lecturer respondents (n=6). The remaining 30 student respondents were not asked this question as they are not employed in higher education.

Section B: System Usability and Functionality

This section shows how respondents rated the usability and functionality of CSSAP. The respondents showed overwhelmingly positive ratings across all dimensions. No items received any Strongly Disagree (1) responses, and only one item (Login and authentication work correctly) received a single Disagree (2) response, representing 2.8% of respondents. Mean scores ranged from 4.69 to 4.86 on a 5-point scale, indicating strong to excellent agreement.

Table 3

Summary of usability and functionality evaluation results (N = 36)

No	Item	Mean(1-5)	Agree/Strongly Agree (%)
1	The CSSAP system is easy to use	4.72	100
2	The system interface is clear and understandable.	4.72	100
3	Login and authentication work correctly	4.69	97.2
4	Attendance data entry is simple and efficient.	4.75	100
5	Cross-subject attendance viewing is useful.	4.81	100
6	Alerts help identify at-risk students early.	4.86	100
7	The dashboard supports decision-making for student barring.	4.86	97.2
8	I would recommend this system to my institution.	4.78	100
9	Overall, I am satisfied with the CSSAP system	4.81	100

Note: Percentages represent the proportion of respondents who selected "Agree" (4) or "Strongly Agree" (5) on a 5-point Likert scale. No respondent selected "Strongly Disagree" (1) for any item.

The highest scores were recorded for "Alerts help identify at-risk students early" (mean 4.86) and "The dashboard supports decision-making for student barring" (mean 4.86), confirming the system's effectiveness in its core purpose. The cross-subject attendance viewing feature also received exceptional

approval (mean 4.81), validating the system's innovative approach to attendance monitoring. Functionality-related items such as attendance entry, calculation accuracy, and lecturer intervention features all scored above 4.75, demonstrating robust technical performance.

Section C: Qualitative Feedback and System Weaknesses

Many users (34.8%) reported no difficulties while using the application, describing their experience as seamless. However, some users reported a learning curve due to multiple features (26.1%) and minor interface and navigation issues (21.7%), such as inconsistent button design and searching through long student lists. A few respondents reported occasional system glitches (8.7%), such as data not saving properly.

When asked about the most useful features, respondents highlighted:
- Alert system & early warning notifications (34.6%)
- Dashboard & attendance visualisation (26.9%)
- Cross-subject / cross-lecturer attendance view (23.1%)

Suggested improvements included:
- Enhanced search & filter functions (30.4%)
- Exportable/printable reports (21.7%)
- In-system help or support features (17.4%)
- Interface simplification and consistency (17.4%)

Discussion of Evaluation Results

The positive reception of the CSSAP dashboard and its alerting functionality aligns with findings that students value systems which provide clear structure and facilitate efficient academic planning. Furthermore, the development of a specialised web platform resonates with solutions proposed in similar contexts, where integrating technology into attendance monitoring and intervention processes has been shown to address the core motivational and logistical factors behind absenteeism (Mokhtari et al., 2021). The evaluation results demonstrate that CSSAP provides an intuitive user interface that delivers an excellent user experience. The consistently high Likert scale scores across all sections, usability, functionality, dashboard features, and user acceptance, indicate strong validation of the system's design and implementation. Notably, the system's core innovative features (cross-subject viewing and automated alerts) received the highest praise, confirming they effectively address the identified problem of fragmented attendance monitoring.

The high willingness to use the system in real practice (75% strongly agree) and recommend it to institutions (77.8% strongly agree) reflects strong user confidence in CSSAP's relevance and usefulness. The fact that 88.9% of respondents strongly agreed that the dashboard supports fairer barring decisions directly validates the system's primary objective of promoting equitable academic governance. The strong user endorsement of features that promote fair and informed decisions aligns with research findings that students themselves often advocate for structured monitoring and consequences for absenteeism, viewing them as essential for an equitable academic environment (Muir, 2009).

While the overall feedback is highly positive, the qualitative suggestions highlight practical refinements to enhance daily usability. Implementing advanced search/filter capabilities and report export functions would address the most frequently mentioned needs. The reported minor navigation issues could be resolved through interface refinements in future iterations.

These results confirm that the CSSAP application is highly usable, functionally robust, and well-received by both students and lecturers. The evaluation indicates excellent performance across navigation, functionality, and design, with clear areas for improvement identified for future updates. The system's readiness for implementation is strongly supported, with 66.7% of respondents strongly agreeing it is ready with only minor improvements needed.

CONCLUSION

The project achieved its goals by developing the Cross-Subject Student Attendance Pattern (CSSAP) system, which serves UUM lecturers and administrators. The project's development was restricted by time limitations, which prevented the implementation of certain enhancements. Future work will focus on three primary functions derived from feedback: advanced search/filter options, exportable reports, and interface navigation improvements. The system now functions properly, enabling lecturers to monitor attendance, identify at-risk students, and record interventions.

This system requires future improvements to be complete, making data management more efficient through better search tools. Lecturers and administrators will be able to generate official documentation directly when the report export feature is implemented. The platform demonstrates how centralised attendance monitoring can support fairer academic decisions and early student intervention.

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