



Development of a web-based teacher scheduling system for Benedicto College using rapid application development

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Abstract

Efficient scheduling is critical for optimizing resource allocation in educational institutions. Benedicto College currently relies on manual scheduling processes that are time-consuming, prone to human error, and frequently result in scheduling conflicts and delayed timetable releases. This study employed the Rapid Application Development (RAD) methodology to design and implement a web-based Teacher Scheduling System. The system was developed using Visual Studio Code with a secure database structure. Testing revealed that the system successfully automates schedule creation, detects conflicts in real-time with 100% accuracy, and enables teachers to view schedules online. The developed system effectively addresses manual scheduling inefficiencies by streamlining administrative tasks, minimizing conflicts, and improving schedule accessibility. The system achieved a System Usability Scale score of 82.5, indicating excellent user acceptance.

Keywords: Teacher scheduling system; Rapid application development; Conflict detection; Academic scheduling; Web-based system

1. Introduction

In educational institutions, efficient scheduling plays a significant role in maintaining high standards of service for students and faculty. Academic scheduling involves coordinating multiple variables, including teacher availability, subject assignments, classroom allocation, and workload distribution. When executed effectively, scheduling ensures that teachers are assigned to classes aligned with their expertise, classrooms are utilized optimally, and teaching loads are distributed equitably. Conversely, poorly managed scheduling can lead to teacher overload, conflicting time slots, unassigned subjects, and delayed timetable releases ^[1, 2].

Benedicto College in Cebu City, Philippines, currently relies on traditional manual methods for teacher scheduling operations. The scheduling staff manually coordinate teacher assignments, subject allocations, and room designations using spreadsheets and physical records. While functional, this approach lacks the speed, accuracy, and adaptability that computerized web-based systems provide. The manual process requires administrators to simultaneously consider numerous variables, rendering it time-consuming and susceptible to human error. Common issues include double-booking of teachers or rooms, uneven workload distribution, and extended periods required to resolve scheduling conflicts.

Studies in higher education have consistently highlighted that the absence or delayed adoption of dedicated digital tools contributes to operational inefficiencies ^[3]. Recent trends, including larger class sizes and increased subject specialization, have intensified these challenges. The COVID-19 pandemic exposed vulnerabilities in manual scheduling systems, as institutions faced unprecedented disruptions requiring rapid modifications that paper-based systems could not accommodate efficiently ^[4].

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Commercial scheduling solutions such as Docendo and StudentSort demonstrate that technology can significantly reduce administrative burden while improving timetable quality ^[5, 6]. However, many educational institutions, particularly smaller colleges in developing regions, face barriers including licensing costs and customization requirements. Benedicto College's decision to develop an in-house system addresses these challenges by creating a solution tailored to local operational context and budgetary constraints.

The primary objective was to design, develop, and implement a web-based Teacher Scheduling System using Rapid Application Development (RAD) methodology. RAD's iterative and user-centered approach facilitates quick prototyping, continuous stakeholder feedback, and faster deployment ^[7]. The specific objectives were: (1) to design a scheduling interface for managing teacher availability, subject assignments, and room allocations; (2) to implement conflict detection features; (3) to integrate a web-based module for real-time schedule viewing; (4) to assess system usability; and (5) to develop a modification interface for handling schedule adjustments.

2. Materials and methods

This study employed an applied research approach conducted at Benedicto College's Office of the Registrar, where scheduling operations are centrally managed by two staff members. The research followed the Rapid Application Development (RAD) methodology, which prioritizes rapid prototyping, iterative development, and continuous user involvement ^[8, 9]. RAD was selected because it enables quick delivery of functional prototypes for stakeholder evaluation, accommodates changing requirements, and allows incremental refinement based on user feedback.

System prototyping served as the primary development technique, involving creation of initial simplified versions for demonstration and feedback. Semi-structured interviews were conducted with scheduling staff to understand workflows, identify pain points, and document functional requirements. Several conceptual models were developed: the Use Case Model described user-system interactions; the Class Model represented structural organization of system entities; and the Entity-Relationship Model provided a visual representation of the database structure with proper referential integrity.

Development utilized Visual Studio Code as the primary IDE, Figma for user interface design, and GitHub for version control. Microsoft Edge and Google Chrome browsers were used for testing. The development timeline included: research planning (February, weeks 1-2); requirements gathering (February week 3 through March week 4); design and prototyping (April through July); and implementation and deployment (August through October).

Functional requirements identified input requirements (user registration, teacher profiles, course and subject details, room and time slot information), processing requirements (authentication, CRUD operations, schedule creation with conflict checking), and output requirements (dashboard views, calendar visualization, printable schedules). Non-functional requirements addressed security (password encryption, role-based access control), usability (user-friendly interface, meaningful error messages), and performance considerations.

3. Results and discussion

The developed Teacher Scheduling System was successfully implemented as a web-based application comprising six core modules: Teacher Profile Management, Schedule Assignment, Automated Conflict Detection, Schedule Adjustment Interface, Secure Database Management, and Reporting and Workload Analytics. These modules collectively address the full range of scheduling operations required by Benedicto College's Office of the Registrar, from data entry through schedule distribution. The system's modular architecture ensures that each functional area operates independently while maintaining data integrity across modules. Table 1 summarizes the core system modules and their primary functions.

Table 1 Core System Modules and Functions

Module	Primary Function	Key Features
Teacher Profile Management	Store and manage teacher information	Add, edit, delete teacher records
Schedule Assignment	Assign teachers to schedules	Calendar interface; workload balancing
Conflict Detection	Identify scheduling conflicts	Real-time alerts; error prevention
Schedule Adjustment	Enable schedule modifications	Manual override; change tracking
Database Management	Protect scheduling data	Encryption; access control
Reporting & Analytics	Generate administrative reports	Load summaries; distribution reports

The Teacher Profile Management module provides administrators with comprehensive capabilities for maintaining teacher records, including contact information, specialization areas, and maximum allowable teaching units. The Schedule Assignment module presents an intuitive calendar interface where administrators create assignments by selecting teachers, subjects, rooms, and time slots through dropdown menus populated from the database. The system's rule-based conflict detection algorithm identifies three primary conflict types: teacher double-booking, room conflicts, and time slot overlaps. Testing across 60 conflict scenarios achieved 100% detection accuracy, as detailed in Table 2. When conflicts are detected, the system displays an error message requiring resolution before the schedule entry can be saved, ensuring no conflicts enter the database.

Table 2 Conflict Detection Test Results

Conflict Type	Test Cases	Detected	Accuracy (%)
Teacher Double-Booking	25	25	100
Room Conflict	20	20	100
Time Slot Overlap	15	15	100
Total	60	60	100

For teachers, the system provides a simplified interface focused on schedule viewing and personal information management. Upon authentication, teachers access a personal dashboard displaying assigned schedules in weekly calendar format with color-coding to distinguish class types. This addresses the identified need for convenient online access without consulting physical bulletin boards. System usability was evaluated through functional testing and the System Usability Scale (SUS) administered to five users. The average score of 82.5 falls within the "excellent" usability range, as scores above 68 are considered above average ^[10]. Scheduling staff particularly appreciated the conflict detection feature, while teachers expressed satisfaction with online schedule access. Figures 1 and 2 illustrate the login page interface and the schedule management dashboard, respectively.

**Figure 1** Login Page Interface of the Teacher Scheduling System

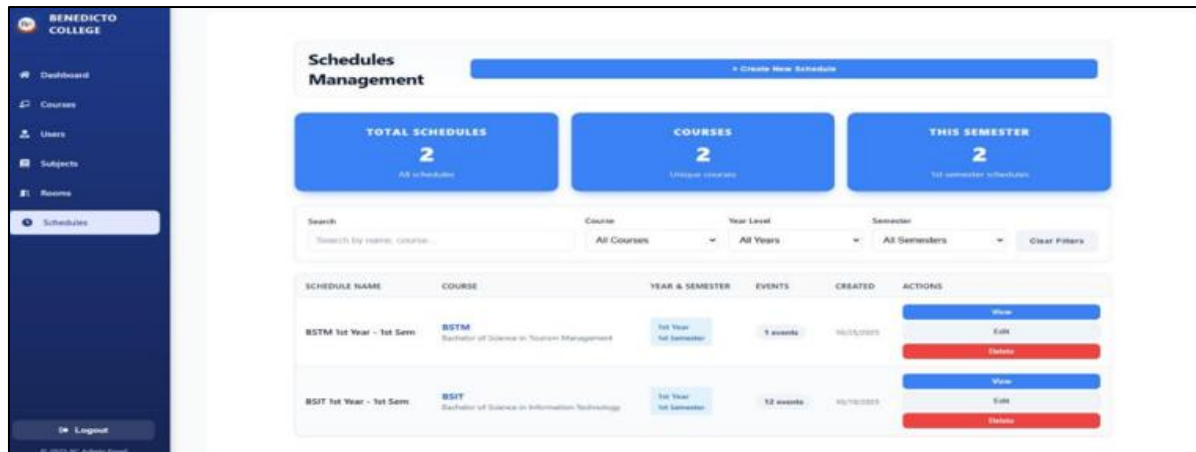


Figure 2 Schedule Management Dashboard Showing Administrative Interface

4. Discussion

The findings demonstrate that a web-based Teacher Scheduling System developed using RAD methodology can effectively address scheduling challenges in educational institutions. The 100% conflict detection accuracy and SUS score of 82.5 indicate successful implementation and user acceptance, aligning with previous research showing that automation reduces administrative workload and improves scheduling accuracy [3, 4]. The results compare favorably with commercial systems such as Docendo and StudentSort, which also employ automated conflict prevention [5, 6].

The system's strengths include a rule-based conflict detection algorithm that provides reliable error prevention without requiring the computational complexity of AI-driven optimization, making it practical for institutions with limited technical infrastructure. The separation of administrator and teacher interfaces ensures appropriate access control while enabling efficient operations for both user groups. The web-based architecture further facilitates remote access, which is particularly relevant given the increasing need for flexible administrative tools.

Several limitations warrant acknowledgment. The system was designed specifically for Benedicto College's practices and may require customization for different institutional policies. It depends on accurate input data; incorrect information will be reflected in generated schedules. While effective for standard scenarios, highly complex scheduling requirements may exceed current capabilities. The web-based architecture requires stable internet connectivity. Additionally, the study evaluated usability with a limited sample of five users, which, while sufficient for an initial assessment, may not capture the full range of user experiences across a larger population.

The study demonstrates the applicability of RAD methodology in developing practical solutions for academic administration and highlights the feasibility of developing institution-specific solutions as alternatives to commercial software. Future research could explore integration of machine learning algorithms for schedule optimization, development of mobile applications, and longitudinal studies examining long-term operational impact.

5. Conclusion

This research successfully developed a web-based Teacher Scheduling System for Benedicto College using RAD methodology. The system addresses inefficiencies of manual scheduling by providing automated schedule creation, real-time conflict detection with 100% accuracy, and convenient online schedule access for teachers. The SUS score of 82.5 confirms excellent user acceptance.

The findings indicate that web-based scheduling systems offer significant advantages over manual processes, including time savings, improved accuracy, and enhanced stakeholder satisfaction. The RAD methodology proved effective, as its iterative approach allowed continuous refinement based on user feedback. The system's modular design supports maintainability and potential extension to other administrative functions.

Future enhancements may include a dedicated mobile application, substitute teacher management functionality, advanced analytics and reporting features, and machine learning algorithms for schedule optimization. Longitudinal studies should evaluate long-term impact on institutional efficiency across multiple academic terms. Additionally,

extending the system to support multi-campus scheduling and integration with existing student information systems could further enhance its utility for educational institutions.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest associated with the publication of this manuscript. No financial or personal relationships with any individuals or organizations have influenced the research design, data collection, analysis, interpretation, or the decision to submit this manuscript for publication.

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