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Design of a Web-Based Academic Information System Using the Zachman Framework: A Case Study at MAN 4 Cirebon

Perancangan Sistem Informasi Akademik Berbasis Web Menggunakan Zachman Framework: Studi Kasus MAN 4 Cirebon

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ABSTRACT

Manual academic administration at MAN 4 Cirebon causes recurring problems in student data management, attendance recording, grade processing, scheduling, assignment submission, and academic reporting. This study designs a web-based Academic Information System using the Zachman Framework to align school needs, stakeholder roles, data structures, business processes, technology infrastructure, and implementation rules in a systematic architecture. The research used a design and development approach based on observation, documentation, and stakeholder requirement analysis. The Zachman perspectives were mapped into planner, owner, designer, builder, detailed representation, and functioning system views. The design outputs include stakeholder-role mapping, use case diagrams for students, teachers, staff, principals, and administrators, a class diagram, network topology, and prototype interface pages. The proposed system supports role-based access, integrated academic data, digital attendance, grade management, schedule management, assignment submission, and academic reporting. The results show that the Zachman Framework helps structure academic information system requirements into coherent architectural artifacts, reducing design ambiguity and supporting more reliable implementation. Future work should test usability, security, data migration, and system performance after web deployment.

Keywords:

Academic Information System; Enterprise Architecture; MAN 4 Cirebon; Web-Based System; Zachman Framework

ABSTRAK

Administrasi akademik manual di MAN 4 Cirebon menimbulkan masalah berulang dalam pengelolaan data siswa, pencatatan absensi, pengolahan nilai, penjadwalan, pengumpulan tugas, dan pelaporan akademik. Penelitian ini merancang Sistem Informasi Akademik berbasis web menggunakan Zachman Framework untuk menyelaraskan kebutuhan sekolah, peran pemangku kepentingan, struktur data, proses bisnis, infrastruktur teknologi, dan aturan implementasi ke dalam arsitektur yang sistematis. Penelitian menggunakan pendekatan perancangan dan pengembangan berdasarkan observasi, dokumentasi, serta analisis kebutuhan pengguna. Perspektif Zachman dipetakan ke dalam sudut pandang planner, owner, designer, builder, detailed representation, dan functioning system. Hasil rancangan mencakup pemetaan peran pengguna, use case diagram untuk siswa, guru, staf, kepala sekolah, dan administrator, class diagram, topologi jaringan, serta halaman prototipe antarmuka. Sistem yang diusulkan mendukung akses berbasis peran, integrasi data akademik, absensi digital, pengelolaan nilai, jadwal, pengumpulan tugas, dan pelaporan akademik. Temuan menunjukkan bahwa Zachman Framework membantu menyusun kebutuhan sistem informasi akademik menjadi artefak arsitektur yang koheren, mengurangi ambiguitas desain, dan mendukung implementasi yang lebih andal.

Kata Kunci:

Sistem Informasi Akademik; Arsitektur Enterprise; MAN 4 Cirebon; Sistem Berbasis Web; Zachman Framework

1. INTRODUCTION

Educational institutions increasingly depend on information systems to manage data, accelerate reporting, and support learning services. In academic administration, information systems help schools record, process, and distribute data in a more accurate and timely manner [1]-[3]. Prior studies on web-based academic information systems also show that digital platforms can improve student data management, administrative efficiency, and access to academic information [4]-[6].

MAN 4 Cirebon is a senior Islamic secondary school with four academic specialization areas: social sciences, natural sciences, religious studies, and language studies. Based on school data used in this study, the school had 910 students and 59 teachers in 2025. This scale creates a high administrative load, especially when student records, attendance, grades, schedules, and assignments are still managed through manual or fragmented procedures.

The operational problem is not limited to data entry. Manual attendance recording can cause recording errors, data loss, and weak traceability. Assignment submission in physical form makes it difficult for teachers to monitor documentation consistently. Grade processing and academic reporting also become vulnerable to duplication, late reporting, and inconsistent access among teachers, students, administrative staff, and school leaders. Although the school already has a website, its current function is mainly informational and does not yet integrate academic transactions.

Academic information systems are commonly defined as integrated systems that manage educational data, users, schedules, grades, attendance, and reports [7]-[11]. However, system development at school level often fails when the design only focuses on interface creation and ignores data ownership, process alignment, role-based access, infrastructure, timing, and institutional motivation. This study therefore uses the Zachman Framework as the architectural basis. The framework organizes information system design through six interrogatives: what, how, where, who, when, and why [12]. It is also widely discussed as an enterprise architecture framework that supports structured representation from business and technical perspectives [13].

Several studies have applied Zachman Framework to school finance systems, health human resource information, academic blueprints, and academic information systems [14]-[17]. This study extends that direction by applying the framework to MAN 4 Cirebon and producing a complete architecture-oriented design for a web-based academic information system. The main contribution is a structured set of artifacts that connects school problems, stakeholder needs, data architecture, process models, infrastructure design, access control, and prototype interface pages.

2. METHODS

2.1. Research Design

This study used a design and development approach with MAN 4 Cirebon as the case study object. The research focused on the design of a web-based academic information system rather than post-deployment performance measurement. The main activities consisted of requirement identification, stakeholder analysis, architecture mapping with the Zachman Framework, UML modeling, database structure design, network topology design, interface prototyping, and design validation.

Data were collected through documentation review and requirement analysis related to student data, teacher data, class data, subject data, attendance, grades, schedules, assignments, and academic reports. Conceptual references on academic activities, education, information systems, and web-based systems were used to strengthen the analysis and terminology [18]-[23].

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2.2. Zachman Framework Mapping

The Zachman Framework was applied by mapping academic system requirements into six questions. The What column identified academic data entities. The How column described academic processes. The Where column described implementation location and technology infrastructure. The Who column identified actors and access rights. The When column defined the system usage and development timeline. The Why column explained system objectives, constraints, and security rules.

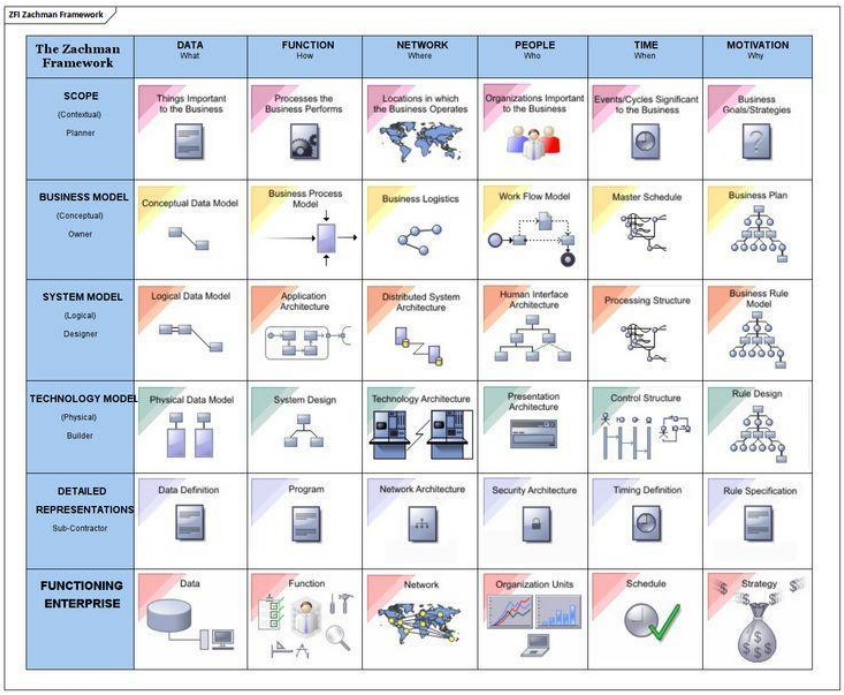

Figure 1. Zachman Enterprise Framework

The framework was interpreted through six design perspectives: planner, owner, designer, builder, detailed representation, and functioning system. Each perspective produced a different level of abstraction, from school-level scope to technical implementation rules and prototype behavior.

2.3. Stakeholder and Development Schedule

Table 1. Representative Stakeholders and System Roles

No.	Representative User	Role	Main Access Requirement
1	Hj. Uswatun Hasanah, M.Ag.	Principal	Academic reports, attendance recapitulation, grade monitoring, and decision support
2	Moch. Zaenil Alam, S.Pd.I	Administrator	System configuration, user accounts, academic master data, and backup control
3	Efik Abdinizar, S.Pd.	Administrative Staff	Student data, teacher data, class data, subject data, schedules, and reports
4	Drs. H. Yanto Apriyanto, M.Pd.I	Teacher	Attendance input, grade input, learning material management, and assignment monitoring
5	Alisya Novarina	Student	Grades, schedule, learning materials, assignment submission, and payment information

Table 2. System Design and Development Schedule

No.	Task Name	Duration	Start	Finish
1	Requirement analysis and system design	30 days	01/12/2025	30/12/2025
2	Application interface and program code development	30 days	01/01/2026	30/01/2026
3	Testing and system implementation	28 days	01/02/2026	28/02/2026

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2.4. Modeling and Validation Procedure

The system was modeled using UML use case diagrams and a class diagram. The use case diagrams were used to validate whether each actor had appropriate access to academic functions. The class diagram was used to validate data relationships among major entities such as students, teachers, classes, subjects, schedules, grades, assignments, attendance, and users. Network topology and interface prototypes were then prepared to show implementation readiness. The validation procedure was limited to internal consistency checking between requirements, actors, processes, data entities, and prototype functions. It did not yet include large-scale usability testing or security penetration testing.

3. RESULTS

3.1. Current Academic Administration Condition

The analysis found that MAN 4 Cirebon needs a system that can integrate academic data and reduce dependence on manual recording. The main academic processes requiring digitization are student data management, teacher data management, class and subject management, schedule preparation, attendance recording, grade processing, assignment submission, academic reporting, and payment information access. The proposed system is designed as a web-based platform so that authorized users can access the required information according to their roles.

Table 3. Summary of Zachman-Based System Architecture

Perspective	Main Focus	Design Output
Planner	Scope of academic data, school location, actors, annual usage, and institutional motivation	Academic data list, stakeholder list, school context, and system objectives
Owner	Business process and managerial needs	Process description, report needs, access expectations, and academic control points
Designer	Logical data and process model	Use case diagrams, class diagram, and logical relationship among system entities
Builder	Technology and implementation structure	Laravel-based web design, MySQL database, Apache server, and network placement
Detailed Representation	Interface and detailed behavior	Login page, student dashboard, profile page, schedule page, grade page, and assignment upload page
Functioning System	Operational rules and output functions	Role-based access, data validation, security rules, backup procedure, and academic reporting

3.2. Planner and Owner Perspective

From the planner perspective, the system manages six core data groups: student data, teacher data, academic records, attendance records, schedules, and user accounts. These data groups become the foundation for all system processes. From the owner perspective, the system must support daily academic control, semester-based data updates, examination period grade input, and annual academic evaluation. The owner perspective also defines the expected institutional benefits: more accurate records, faster reports, reduced manual error, improved transparency, and data-based decision support.

The actors identified in the owner perspective are principal, administrative staff, teacher, student, and administrator. The principal consumes reports and monitors academic performance. Administrative staff manage master data and documents. Teachers input attendance, grades, and learning materials. Students access academic information and submit assignments. Administrators maintain accounts, access rights, database security, and system backup.

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3.3. Designer Perspective

The designer perspective converts academic processes into UML models. Five use case diagrams were prepared to represent the interaction between each user role and system functions. The use case diagrams help separate access rights and reduce ambiguity during implementation.

(a) (b)

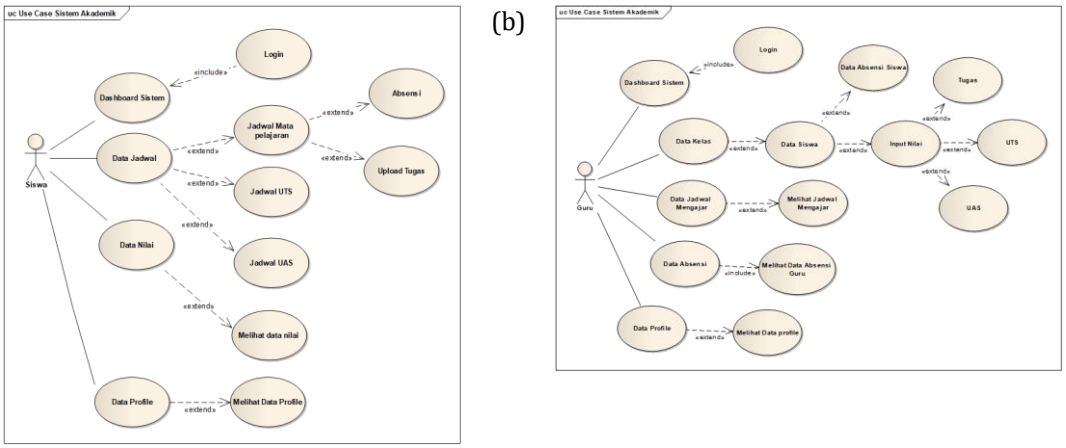

Figure 2. (a) Student Use Case Diagram, (b) Teacher Use Case Diagram

(a) (b)

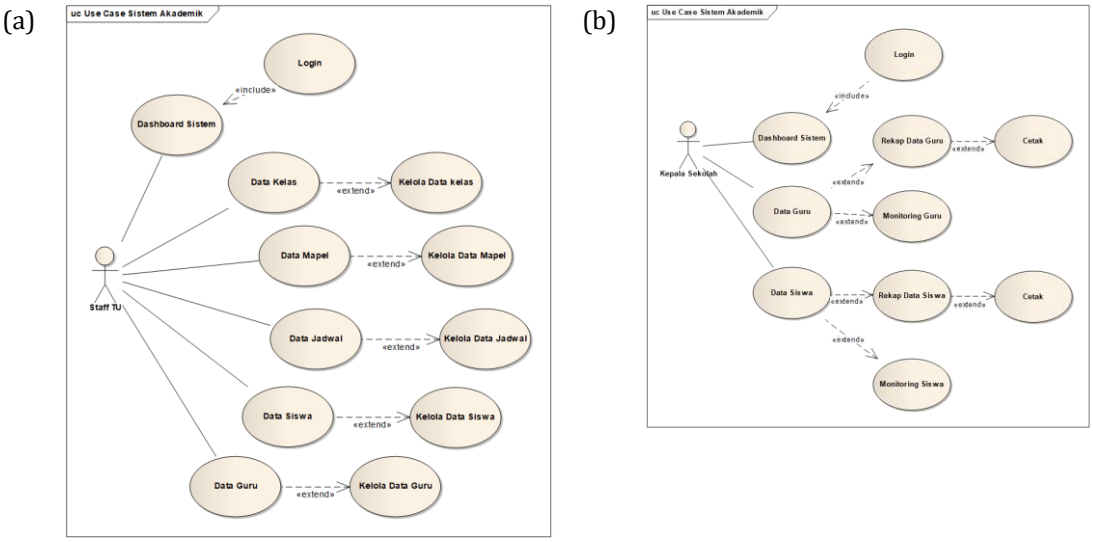

Figure 3. (a) Staff Use Case Diagram, (b) Principal Use Case Diagram

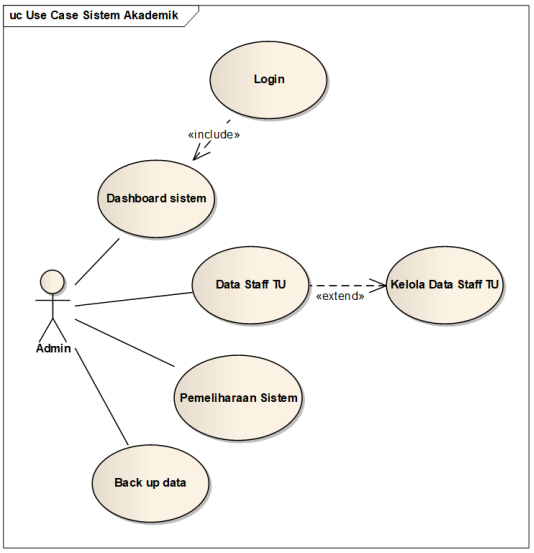

Figure 4. Administrator Use Case Diagram

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The class diagram shows the logical relationship among academic entities. It supports relational database design because each function requires consistent links between users, students, teachers, subjects, classes, schedules, attendance, grades, assignments, and reports.

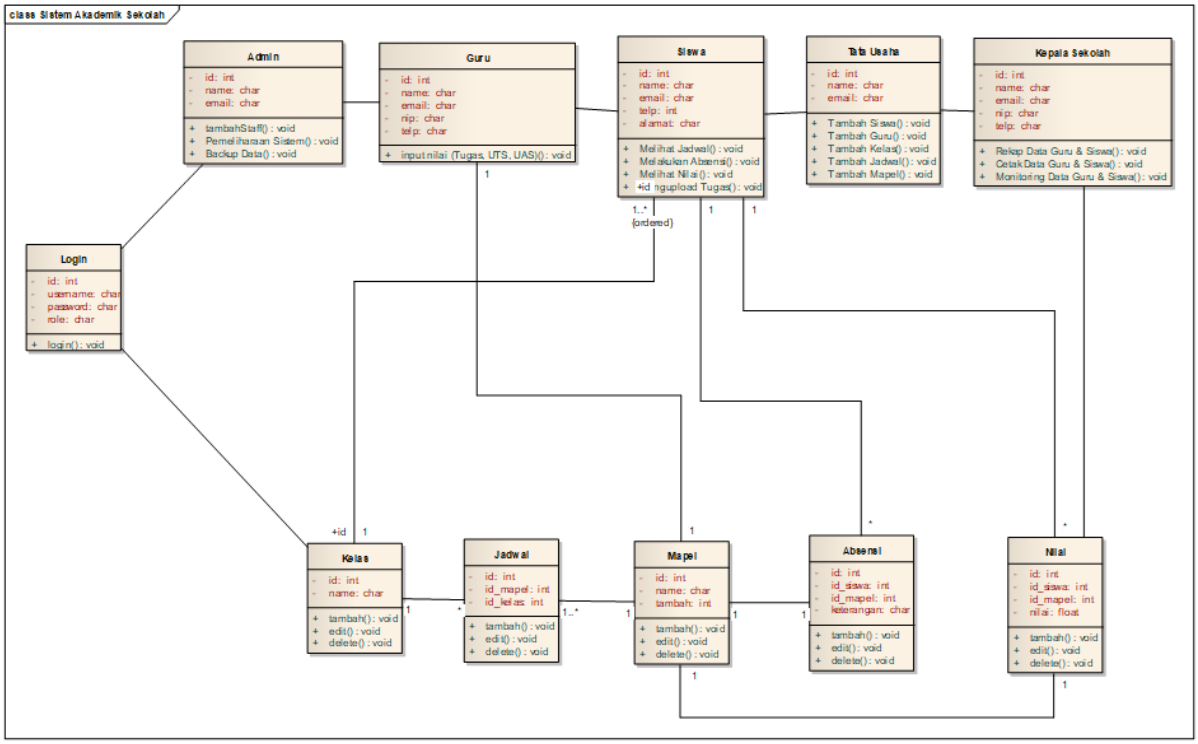

Figure 5. Class Diagram of the Academic Information System

3.4. Builder Perspective

The builder perspective defines the technical direction of the proposed system. The system is designed as a web application using PHP with the Laravel framework, MySQL as the database, HTML, CSS, and JavaScript for the interface layer, and Apache as the web server. Data are stored on a school server with periodic backup. Role-based access is required so that each user can only access data and functions that match the assigned responsibility.

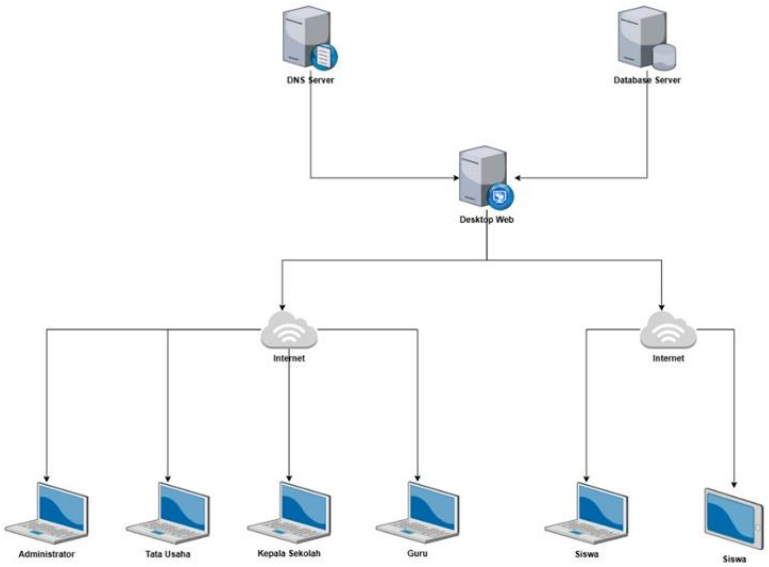

Figure 6. Network Topology for the Proposed Academic Information System

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The network topology supports access through the school network and internet connection. The design includes a server, database storage, client devices, and backup support. This structure allows the school to maintain centralized academic data while providing controlled access to users.

3.5. Detailed Representation and Prototype Interface

The detailed representation perspective translates the architectural design into interface prototypes. The prototype starts with a login page to control authentication. After authentication, users are directed to role-specific dashboards. The student interface includes profile information, schedule access, grade access, learning material access, payment information, and assignment upload.

(a) (b)

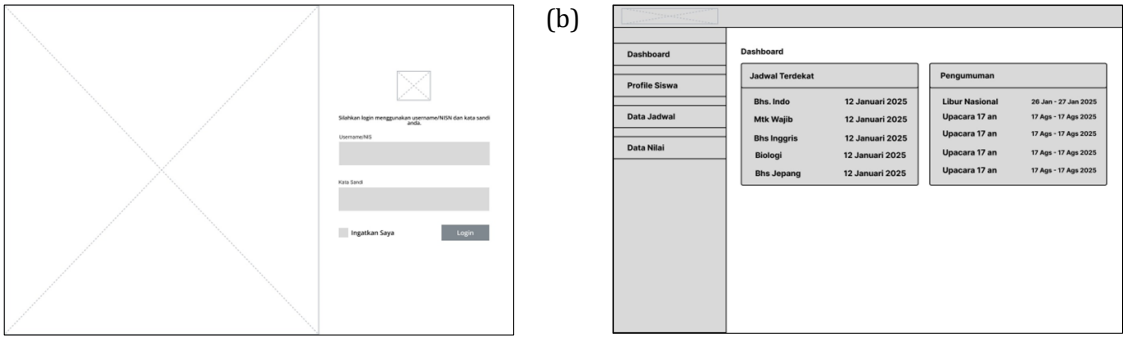

Figure 7. (a) Login Page, (b) Student Dashboard Page

(a) (b)

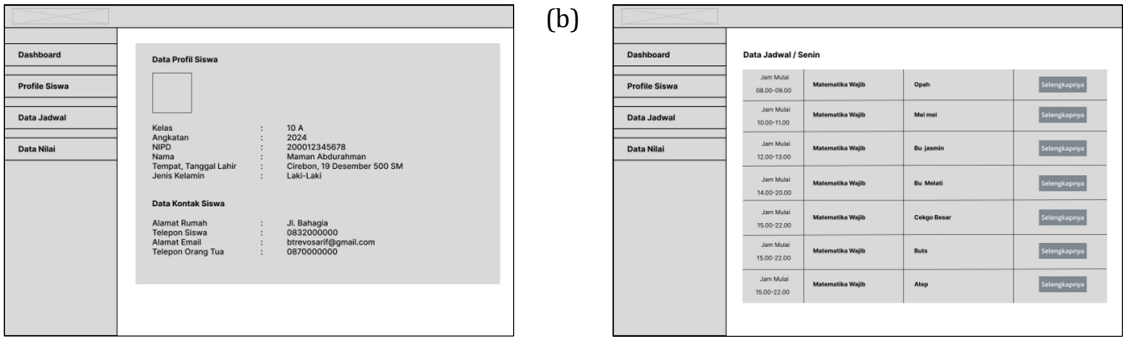

Figure 8. (a) Student Profile Page, (b) Student Schedule Page

(a) (b)

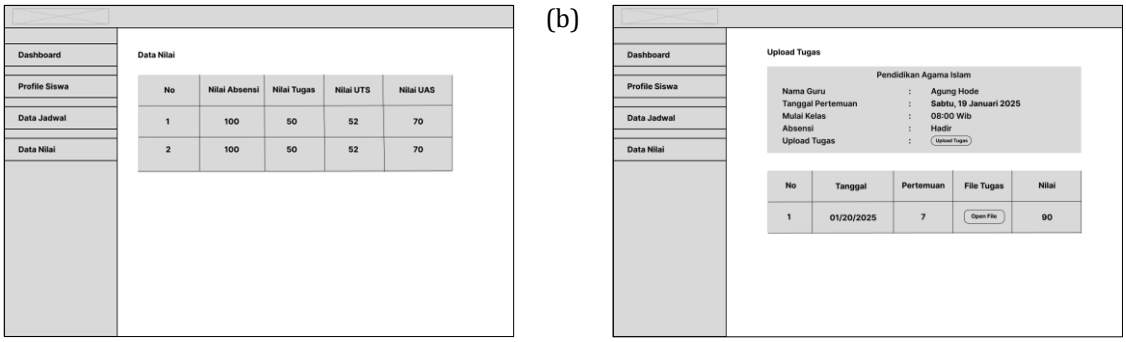

Figure 9. (a) Student Grade Page, (b) Student Assignment Upload Page

The prototype pages show that the design is practical, with each interface aligned to functions in the Zachman matrix. This ensures that interface elements, access rights, and data objects consistently derive from the same requirements.

4. DISCUSSION

The proposed design addresses the main administrative limitations at MAN 4 Cirebon by converting manual academic work into integrated digital services. The strongest contribution of the

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design is traceability. Each feature can be linked to a stakeholder, data object, process, infrastructure component, and institutional motivation. This reduces the risk of building isolated features that do not support the school workflow.

The use of the Zachman Framework also improves architectural clarity. The What column clarifies data ownership and database needs. The How column clarifies business processes. The Where column clarifies infrastructure placement. The Who column clarifies user roles and access rights. The When column clarifies operational timing and development schedule. The Why column clarifies institutional goals and security rules. This structure is relevant for schools because academic services involve many actors who require different levels of access to the same data ecosystem.

Compared with a conventional website, the proposed academic information system provides transactional and managerial functions. Students do not only read public school information, but also access schedules, grades, materials, assignments, and payment information. Teachers do not only submit documents manually, but also manage grades and attendance through the system. Administrative staff can maintain master data, while the principal receives reports for monitoring and decision support.

The design still has limitations. First, this study produces architectural and prototype artifacts, but it has not measured usability with a large user sample. Second, security has been designed conceptually through authentication, access control, input validation, and backup, but it has not been verified through penetration testing. Third, deployment readiness still depends on school infrastructure, user training, data migration quality, and maintenance procedures. Future studies should implement the system, conduct usability testing, measure task completion time, test security risks, and evaluate the impact on reporting accuracy and administrative efficiency.

5. CONCLUSION

This study designed a web-based Academic Information System for MAN 4 Cirebon using the Zachman Framework. The design responds to manual academic administration problems in student data, teacher data, attendance, grades, schedules, assignments, and reports. The resulting artifacts include stakeholder mapping, development schedule, Zachman perspective mapping, use case diagrams, class diagram, network topology, and prototype interface pages.

The findings indicate that the Zachman Framework helps organize school academic system requirements into a coherent architecture. The proposed system supports role-based access, integrated data management, faster academic reporting, and better information transparency for students, teachers, administrative staff, administrators, and school leaders. For submission and implementation purposes, the design should be followed by software development, database migration, functional testing, usability testing, security testing, user training, and periodic evaluation.

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