

# Development of Web-Based Online Exam Application at the Faculty of Engineering, Jabal Ghafur University

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## ABSTRACT

The increasing integration of information and communication technology in education has accelerated the transformation from conventional classroom-based learning to digital platforms. This study presents the design and development of a web-based online examination system for the Faculty of Engineering at Universitas Jabal Ghafur. The system aims to provide an effective and efficient alternative to traditional examinations, ensuring that assessments can be conducted anytime and anywhere without requiring physical meetings. The research applies a mixed methodological approach, combining theoretical review and field research to analyze operational needs and user expectations. The platform is built using the CodeIgniter framework, PHP programming language, and MySQL database, and it integrates core academic functions such as course management, lecturer and student data, class scheduling, exam creation, and learning material distribution. System modeling employs both Entity Relationship Diagram (ERD) and Data Flow Diagram (DFD) to ensure structured and maintainable development. Implementation results show significant improvements in time efficiency, resource optimization, and administrative cost reduction. Beyond improving examination management, this system supports a more flexible, accessible, and technology-driven learning environment that aligns with the ongoing digital transformation in higher education.

## ARTICLE HISTORY

Received 9 March 2025

Accepted 15 October 2025

Published 30 December 2025

## KEYWORDS

Online Examination; Web-Based System; Information System; ERD; DFD.

## 1. Introduction

The rapid advancement of information and communication technology has reshaped the landscape of education, prompting a shift from conventional face-to-face instruction toward digital learning environments (Aloia & Vaporciyan, 2019; Havryliuk *et al.*, 2020). One significant manifestation of this shift is the adoption of online examinations, which enable more flexible and efficient assessment processes compared to traditional paper-based formats. Various educational institutions and professional sectors worldwide, including national recruitment systems, have widely implemented online assessments as part of their operational and pedagogical strategies (Utama, 2019; Ruhyat & Amalga, 2019; Riyadi, Hermaliani & Utami, 2019). Within the Faculty of Engineering at Universitas Jabal Ghafur, assessments are still predominantly conducted in physical classrooms. This dependency on in-person interaction means that if lecturers and students cannot meet, examinations are delayed or canceled, which undermines the continuity of the learning process. To address this issue, the present study seeks to design and develop a web-based online examination application that allows examinations to be conducted without direct physical interaction, while also integrating multimedia features such as audio, video, and image-based questions to enrich the assessment experience (Ahmad & Wali, 2019; Wali & Ahmad, 2017). The system is built using CodeIgniter as the development framework (Tenis, 2018), PHP as the programming language (Baharuddin, Astuti & Mering, 2020), and MySQL as the database platform (Bell, 2018; Kuyumdzhiev, 2019). The research applies two methodological approaches—library research and field research—to gather both theoretical and empirical data.

This digital examination platform aims to provide an efficient management system for courses, teaching materials, exam schedules, and user authentication. It is expected to enhance flexibility, reduce administrative workload, and improve accessibility for both lecturers and students. Prior research has demonstrated the effectiveness of online examination systems in supporting academic activities, including their capacity to automate scoring and provide immediate feedback (Huzaimah & Irfan, 2018). Unlike previous studies, the present work emphasizes the integration of various media formats within the assessment interface, thereby offering a more interactive and adaptive testing environment. In addition to addressing practical challenges faced by the faculty, this initiative aligns with broader technological and educational developments that emphasize systemized and structured digital learning environments (Williams & Hummelbrunner, 2020; Sudirman *et al.*, 2020). By utilizing systematic software development methods such as the waterfall model, the platform is designed to ensure clarity and reliability across the stages of analysis, design, implementation, testing, and maintenance (Iqbal, Aprizal & Wali, 2017; Akbar & Mukhtar, 2019; Iqbal, 2019). This research contributes to the modernization of assessment practices at Universitas Jabal Ghafur and provides a framework that can be adapted for similar educational contexts.

## 2. Methodology

This research adopts a methodological approach that integrates both theoretical and empirical inquiry to ensure the accuracy and applicability of the developed system. Two primary strategies were employed: library research and field research. The library research phase involved collecting theoretical foundations from relevant academic publications, books, and prior studies, which provided conceptual clarity on systems, information flow, and digital learning environments (Davis & Yen, 2019; Lerner, 2018; Herrmann & Pridöhl, 2020). Meanwhile, the field research was carried out through direct observations and interviews to obtain primary data that reflects real operational conditions at the Faculty of Engineering, Universitas Jabal Ghafur. This dual approach allows for a more structured understanding of how online examination systems can be effectively implemented in educational settings. In the context of information systems, several theoretical models were examined to support the development of a functional and sustainable platform. Information is considered a processed form of data that provides meaningful value to its users (Ruzibaeva, 2021; Aksnes, Langfeldt & Wouters, 2019). This distinction between raw data and structured information underscores the necessity of reliable information systems capable of handling data flow efficiently (Pozdniakov *et al.*, 2018; Glad & Ljung, 2018). Information can take various forms, whether factual, analytical, subjective, or objective, and must be communicated in ways that enable stakeholders to make informed decisions (Lerner, 2018). Within organizational systems, key components such as boundaries, subsystems, interfaces, inputs, and outputs interact to create operational coherence, which aligns with established management information system frameworks (Prehanto, 2020; Sudirman *et al.*, 2020; Hutahaeen *et al.*, 2021).

The methodological design also integrates system modeling and development frameworks that emphasize clarity and traceability throughout the software engineering lifecycle. Entity Relationship Diagram (ERD) modeling provides the structural backbone of the database by representing data entities and their relationships in a systematic and visual manner (Amran, Mohamed & Bahry, 2018; Lachová *et al.*, 2019; Latukolan, Arwan & Ananta, 2019). This approach ensures that data architecture is both coherent and adaptable, making future system maintenance and development more manageable. To complement ERD, the Data Flow Diagram (DFD) method is applied to illustrate how data moves within the system, enabling clear visualization of processes, storage, and

external interactions (Soufritri, 2019; Martasubrata & Priyadi, 2019; Wang, 2020). These modeling techniques form the conceptual framework for the application's structure and guide the system design process. The research also examines the pedagogical and technological underpinnings of e-learning as part of the methodological framework. Digital learning is increasingly characterized by synchronous and asynchronous delivery modes, allowing learners to access materials without geographical or temporal constraints (Aloia & Vaporciyan, 2019; Havryliuk *et al.*, 2020; Deng *et al.*, 2019). This aligns with global trends in virtual learning communities, where technology supports both structured and flexible instructional delivery. The e-learning framework is not limited to internet-based platforms; it may also employ offline digital media such as CDs and other storage devices, broadening its accessibility to students in varying contexts.

A key component of this study is the technological infrastructure that enables the deployment of the online examination platform. The website functions as a public-access digital environment that hosts and connects multiple web pages through a unified domain, providing a structured and interactive interface (Yang, Zhao & Zeng, 2019; Jolley, Bray & Maiden, 2018; Mashadi, Nurachmad & Mulyana, 2019). XAMPP serves as the local server environment that integrates multiple essential web development tools, including Apache, MySQL, PHP, and PhpMyAdmin, facilitating testing and deployment across multiple operating systems (Sihotang, 2018; Bou, 2019; Mearaj, Maheshwari & Kaur, 2018). Bootstrap is employed as the front-end framework to ensure responsive design and cross-browser compatibility, which enhances the usability of the system (Hoang *et al.*, 2018; Centeno *et al.*, 2019). PHP, as the server-side programming language, enables dynamic interaction with the database and supports the development of scalable and flexible online applications (Mubarak, 2019; Baharuddin, Astuti & Mering, 2020). Meanwhile, MySQL provides a robust and open-source relational database management system capable of handling structured data securely and efficiently (Combaudon, 2018; Bell, 2018; Kuyumdzhiiev, 2019). Overall, this methodological approach combines theoretical understanding, empirical investigation, and structured system development practices to create a reliable and sustainable web-based examination system. By integrating models such as ERD and DFD with modern web development technologies, this research not only provides a technical solution but also reinforces the theoretical foundation of information system design in educational settings. The resulting platform is designed to optimize data flow, ensure reliable performance, and offer a responsive user interface, thereby supporting the transformation of conventional assessments into accessible, flexible, and efficient online examinations.

### 3. Results

The Faculty of Engineering at Universitas Jabal Ghafur requires a structured and efficient digital system to support teaching and assessment activities without relying on physical meetings. The absence of a centralized online platform for examinations has limited flexibility for both lecturers and students. To address this, an online examination application was conceptually designed to operate as an integrated web-based system, enabling students and lecturers to access learning materials, exams, and assessments anytime and anywhere. The system development process involved several phases, including requirement analysis, system modeling, database structuring, and interface design. The analytical stage began with library and field research to identify the operational weaknesses of the existing system. The primary limitation observed was the absence of a digital assessment platform, resulting in dependency on physical attendance for exams. Data were gathered through observation and interviews with academic staff to understand user needs and expectations. From these findings, it was determined that the system must support user authentication, data entry for courses

and users, material uploads, exam scheduling, and automatic generation of assessment reports.

System requirements were categorized into hardware, software, information, and user capabilities. On the hardware side, the system can operate using standard computing devices such as a laptop equipped with an AMD A10 processor, 6 GB RAM, and a 1 TB hard drive. The software environment consists of Sublime Text, XAMPP, Google Chrome, Windows 10, and Mendeley Desktop. The system outputs are designed to include student and lecturer data, course information, class schedules, uploaded teaching materials, question banks, examination sessions, and grading reports. Only a single trained administrator is required to operate the system, ensuring straightforward maintenance and management. The system design phase employed structured modeling techniques to ensure a clear representation of processes and data flow. The context diagram illustrates three main external entities—Administrator, Lecturer, and Student—interacting through the system. The administrator manages user accounts, class data, and course information. Lecturers upload teaching materials, assignments, and exam questions, while students access the platform to complete assigned exams. After exams are submitted, the system automatically compiles performance reports accessible to both lecturers and students. This logical flow is further refined through the Data Flow Diagram (DFD) at various levels, describing how inputs are processed into structured outputs.

Table 1. Data Dictionary of the Proposed System

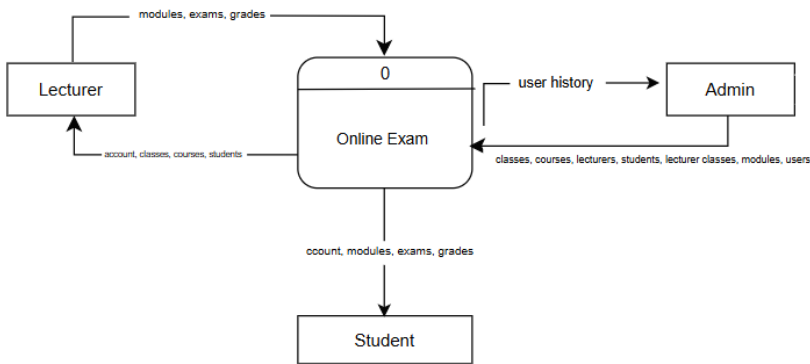
No	Data Flow Name	Description	Frequency	Data Source	Data Destination
1	Dt_ujian	Examination data entered by students	Per exam session	Student	Student
2	Upload_bhnajar	Upload of teaching materials	Each upload	Lecturer	Student
3	dt_mhs	Student data (NPM)	Every input	Student	Student
4	dt_dosen	Lecturer data (NIDN/NIP)	Every input	Lecturer	Lecturer
5	dt_mk	Course data (Course Code)	Every input	Student & Lecturer	Student & Lecturer
6	F_tugas	Assignment file	Every upload	Student & Lecturer	Student & Lecturer
7	F_ujian	Examination file	Every upload	Student & Lecturer	Student & Lecturer
8	F_bhnajar	Teaching material file	Each upload	Lecturer	Student
9	F_mahasiswa	Student file	After data entry	Student	Student
10	F_dosen	Lecturer file	After data entry	Lecturer	Lecturer
11	F_mk	Course file	After course entry	Student & Lecturer	Student & Lecturer

In database design, the system incorporates relational tables to ensure data integrity and efficient retrieval. User authentication and role management are handled through the Users table, which stores essential credentials and access rights. Other key entities include Lecturer, Course, Class, Exam Schedule, Questions, Answers, and Modules. Each table is designed with primary and foreign key relationships, ensuring relational consistency. For example, the Exam Schedule table links class and course data, while the Questions table links directly to specific lecturers and subjects.

Table 2. Users Table Structure

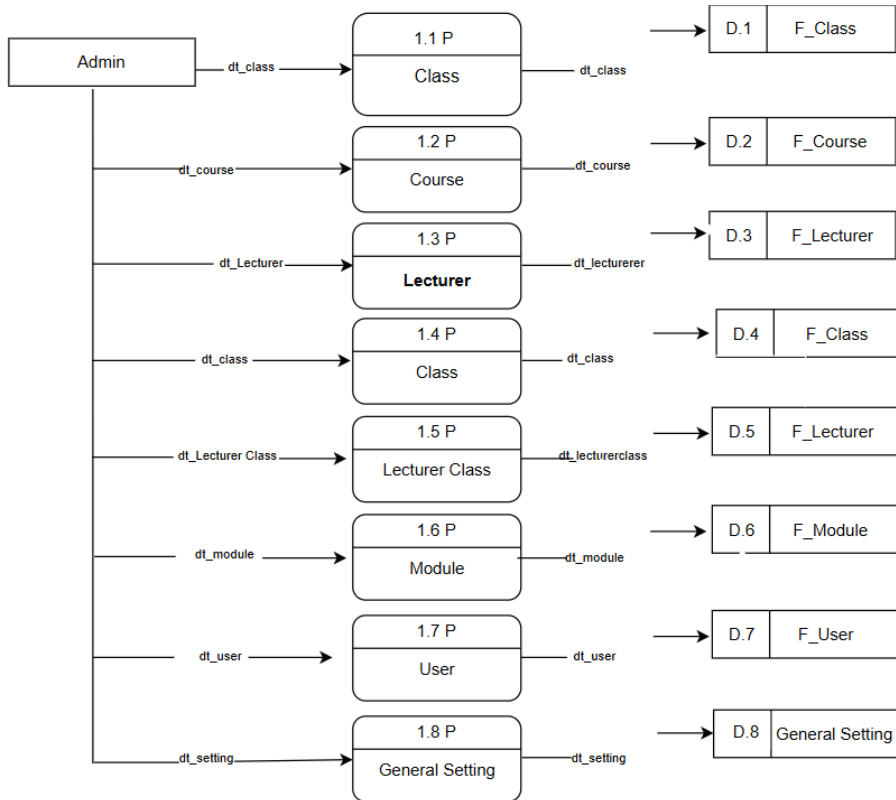
No	Field Name	Data Type	Size	Description
1	Id_User	Int	11	Primary Key
2	Avatar	Varchar	100	Profile image
3	Fullname	Varchar	80	Full name of the user
4	Username	Varchar	80	Login username
5	Password	Varchar	100	Login password
6	Role	Varchar	1	Access level
7	Uploaded	Datetime	-	Date and time of data entry

The interface design focuses on usability and clarity. The landing page provides a secure login form with role-based access control, ensuring different users—admin, lecturer, or student—are directed to the appropriate dashboard. The admin panel manages master data, including student and lecturer records, courses, classes, modules, and user settings. Lecturers have access to exam scheduling, question input (manual entry or Excel import), and teaching material uploads. Students can view schedules, access learning modules, and take exams within the assigned timeframe. Once exams are submitted, scores and reports are automatically updated and made available on both student and lecturer dashboards. The system’s structured design enables real-time information flow and minimizes manual administrative tasks. The DFD level 0 and subsequent level 1 process diagrams outline the relationships between entities and internal processes, including user data entry, file uploads, and reporting mechanisms. This structured approach allows for scalability, making it possible to integrate additional features such as plagiarism detection, automatic grading, or learning analytics in future versions of the platform.



Gambar .1. Diagram Level 0

Figure 1 illustrates the Level 0 Data Flow Diagram, which provides a high-level overview of the entire web-based online examination system. This diagram shows how data moves between external entities, processes, and the main system. The key components include users (administrators, lecturers, and students), the system server, and the database. At this level, the diagram represents the general structure of the system without going into the detailed logic of each process. The purpose of this diagram is to demonstrate how inputs from different users are processed by the system and transformed into outputs, such as exam schedules, question banks, and result reports. It also highlights the interaction between users and the centralized database, ensuring a clear understanding of the system’s overall architecture.



Gambar 2. Rancangan Diagram Arus Data Level 1 Proses 1

Figure 2 depicts the Level 1 Data Flow Diagram for Process 1, which elaborates on the main operational flow within the system. This diagram breaks down the high-level process from Figure 1 into more specific components, showing the interaction between sub-processes such as data entry, question management, exam scheduling, and result processing. Data from administrators, lecturers, and students flow through these sub-processes and are stored in the database, then retrieved when needed to generate reports or facilitate exam activities. By detailing the flow of information and data transformations, this diagram provides a clearer understanding of how the system supports online examination management in a structured and systematic manner.

#### 4. Discussion and Implementation

The implementation of the web-based online examination system at the Faculty of Engineering of Universitas Jabal Ghafur represents a significant step toward digitizing academic evaluation and learning management. The system was developed through four key stages: input design, output design, process design, and program implementation. The input design involves managing essential data entries such as classes, courses, students, lecturers, learning materials, questions, exams, and users. These entries form the foundation for a structured and maintainable academic database. The output design focuses on generating relevant information for users, including class lists, course lists, lecturer and student data, learning materials, question banks, exam schedules, exam results, and user information. During the implementation stage, the system begins with a login page that serves as the main authentication gateway. It supports three access levels: administrator, lecturer, and student. Administrators have full control over academic data management, lecturers

are responsible for managing questions and learning materials, while students can only access exams and course modules according to predetermined schedules.

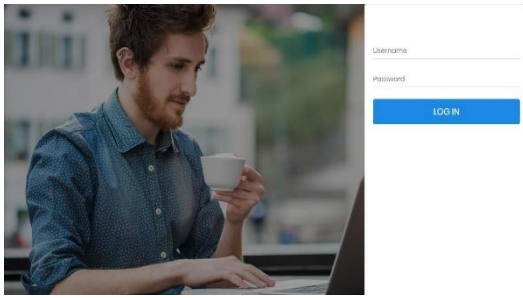


Figure 3. Login Page of the Online Examination System



Figure 4. Administrator Dashboard

This figure 3. Shows the initial login interface where users must enter their username and password. Once authenticated, they are directed to their respective dashboards based on access level. Figure 4. This is the central control panel accessible only to administrators, featuring menus for class, course, lecturer, student, learning material, exam question, user, and system settings management.

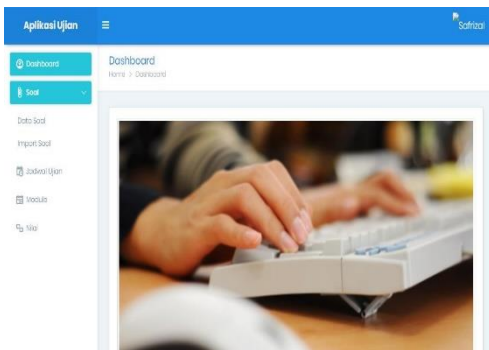


Figure 5. Lecturer Dashboard

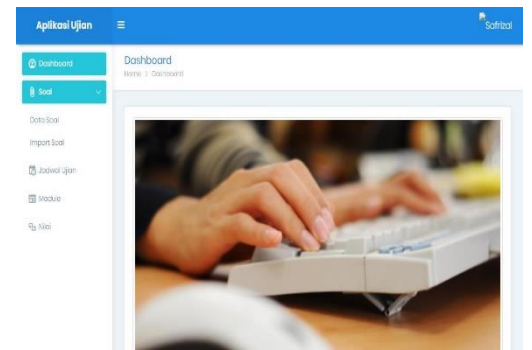


Figure 6. Student Dashboard

Figure 5. This interface provides lecturers with specific features such as question management, question imports, exam scheduling, module uploads, and grading functions. Figure 6. This page displays exam schedules and learning modules that can be accessed by students based on their enrolled classes and courses.

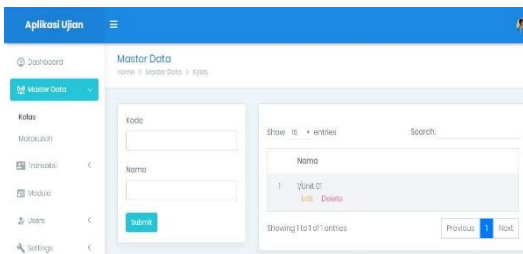


Figure 7. Class Entry Form

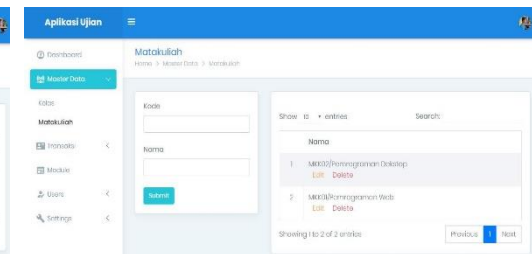
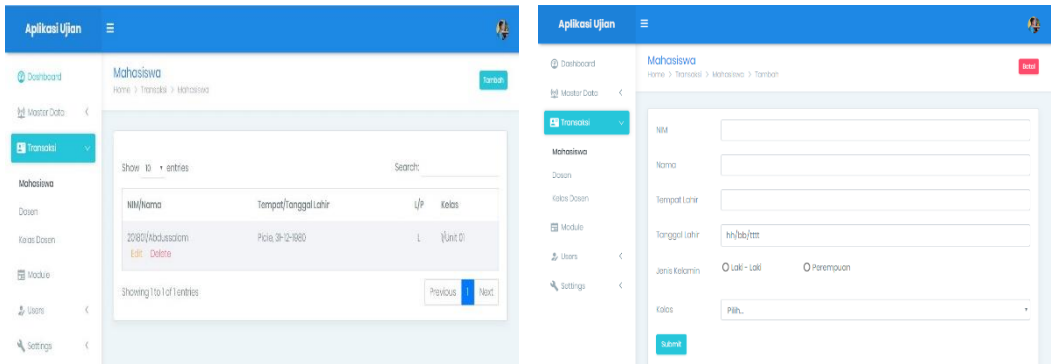


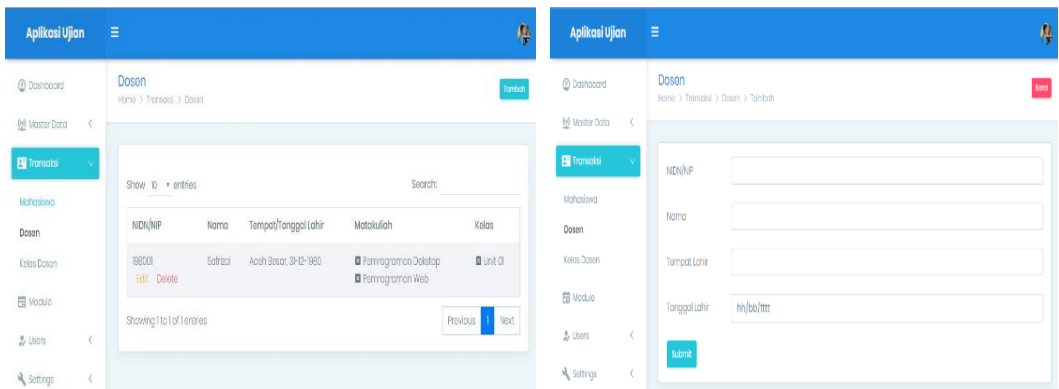
Figure 8. Course Entry Form

Figure 7. This form allows administrators to manage class data dynamically, assigning unique class codes to facilitate connections with courses and lecturers. Figure 8. This page is used to add and manage course data, with search and delete features available in the same view.



Figures 9 and Figure 10. Student Data Form

These figures display a list of students containing NIM, name, birth details, gender, and class. Administrators can add, update, or delete records using action buttons.



Figures 11 and Figure 12. Lecturer Data Form

Similar to the student data form, this feature allows centralized management of lecturer information.

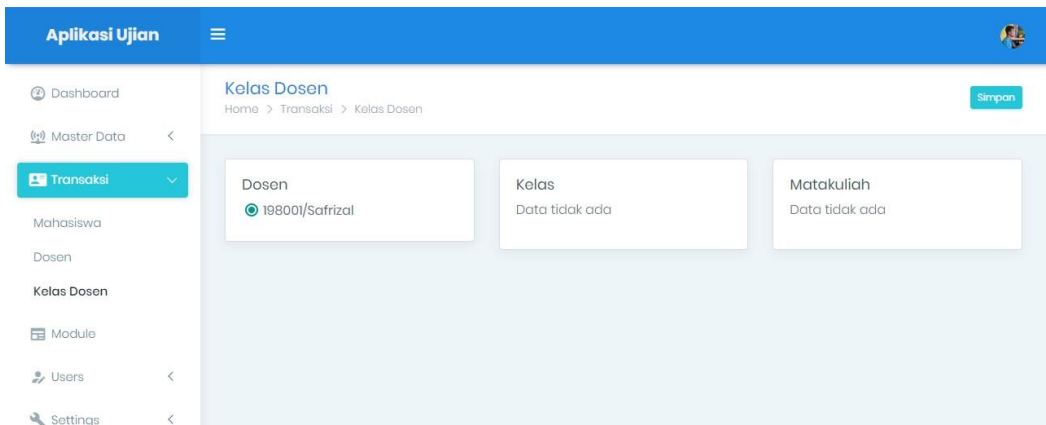
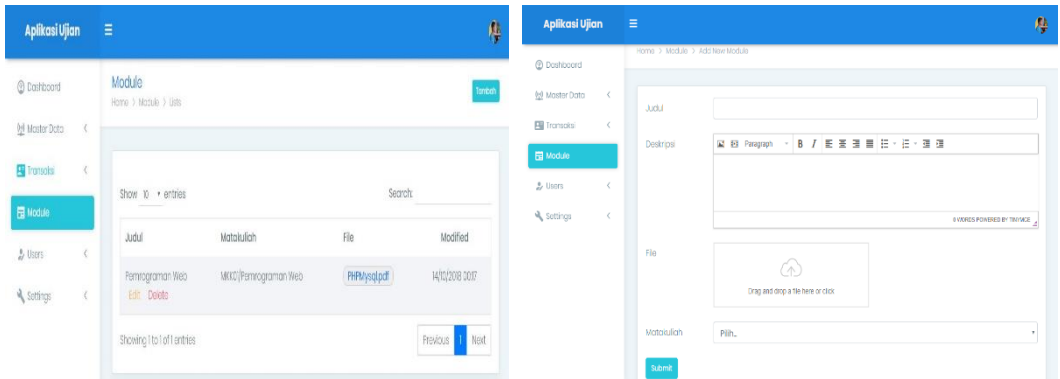


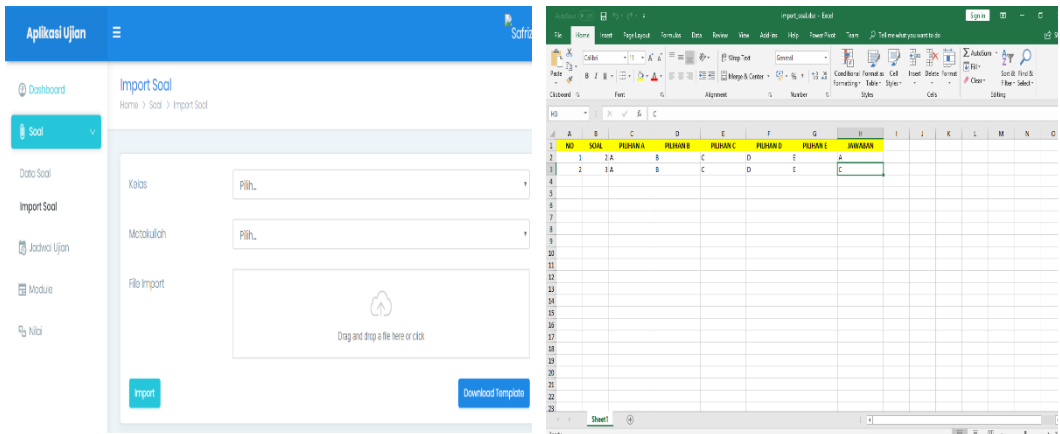
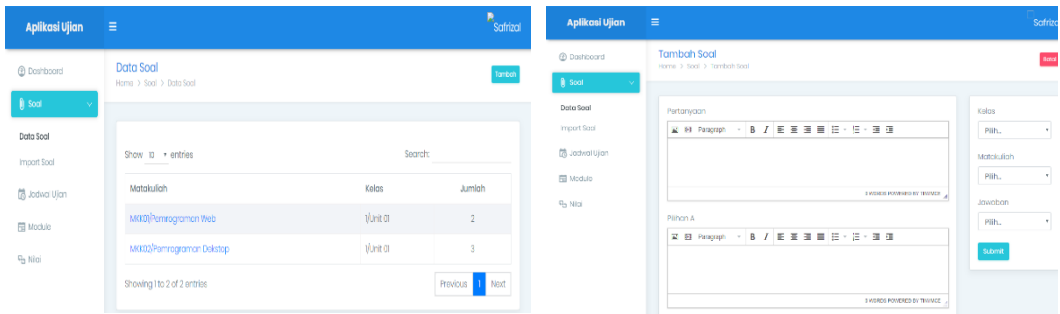
Figure 13. Lecturer-Class Settings

This interface connects lecturers with specific classes and courses they teach, making scheduling more efficient and organized.



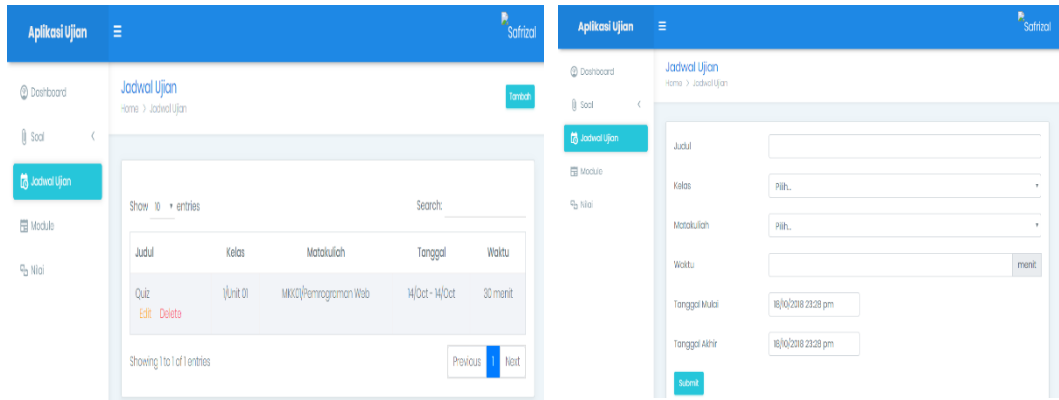
Figures 14 and Figure 15. Learning Module Form

This feature enables lecturers or administrators to upload learning materials in various formats (PDF, DOCX, PNG, JPEG) for student access.



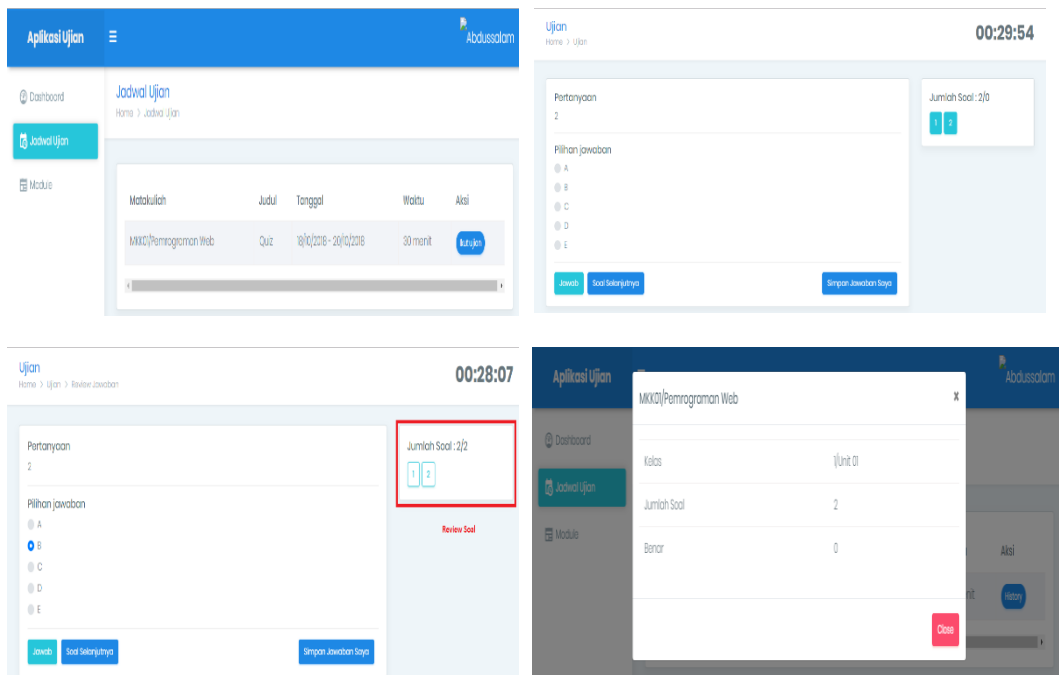
Figures 16-19. Question Form and Excel Template

This page allows lecturers to create and manage exam questions. Questions can be added manually or imported through a pre-formatted Excel template to minimize formatting errors.



Figures 19 and Figure 20. Exam Schedule Form

This interface enables lecturers or administrators to schedule exams by setting the title, class, course, date, and time.



Figures 21 – 24. Student Exam and Result Pages

These figures illustrate the student’s exam process—from selecting available exams, answering questions within the set time limit, reviewing responses, to viewing their results.

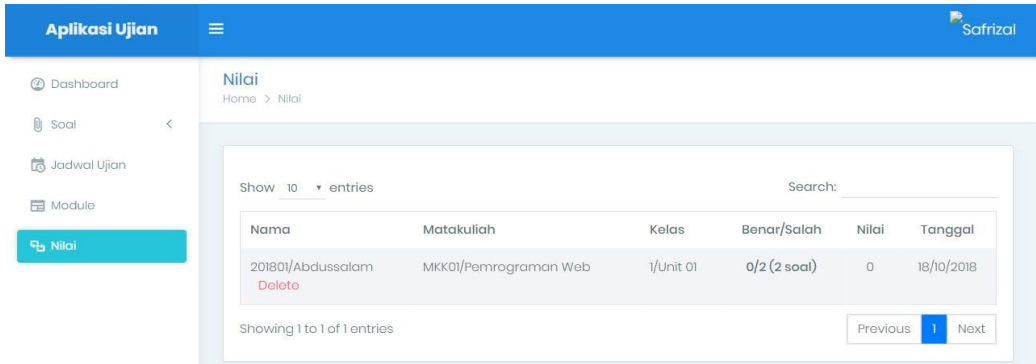


Figure 25. Student Score Recap

This page allows lecturers and administrators to view students' scores, including NIM, name, course, class, number of correct and incorrect answers, and final grades.

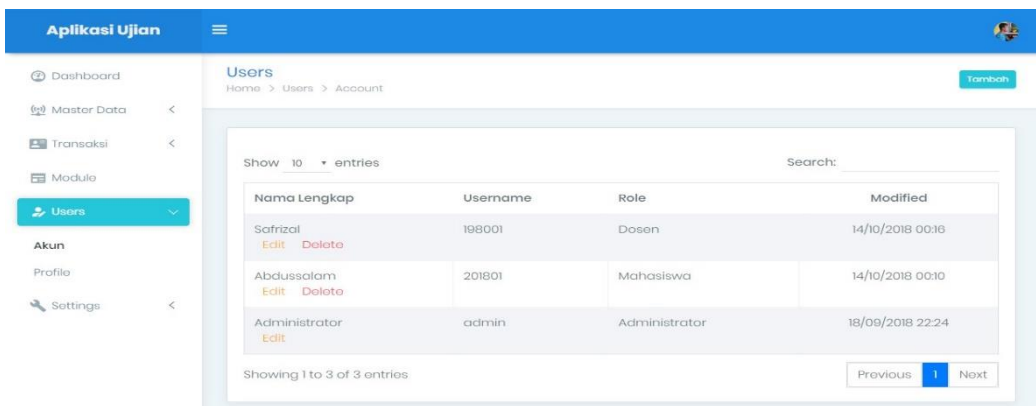


Figure 26. User Management Page

This page is accessible only to administrators for adding, modifying, and deleting user accounts.

The new system demonstrates significant improvements in operational efficiency in terms of labor, time, and cost. Prior to implementation, the examination process required five administrative staff, approximately 225 minutes for data entry, and an annual operational cost of IDR 2,800,000. After the system's introduction, only one operator is needed, data entry time was reduced to 35 minutes, and reporting to 15 minutes.

Table 3. Comparison Between the Old System and the New System

No	Aspect	Old System	New System	Efficiency Impact
1	Labor	5 administrative staff	1 operator	~40% labor reduction
2	Processing Time	225 minutes for data entry, 135 minutes for reporting	35 minutes for data entry, 15 minutes for reporting	~43% faster data entry & 80% faster reporting
3	Operational Costs	IDR 2,800,000 per year	IDR53,560,000 (initial investment with long-term savings)	~86% cost efficiency

Table 3. illustrates the impact of implementing the online examination system. There is a significant reduction in required personnel, processing time, and operational costs, demonstrating the effectiveness of the new digital system.

Overall, the implementation of the web-based online examination system has transformed the academic evaluation process into a more efficient, modern, and technology-driven model. Lecturers can easily create and monitor exams, students can access assessments and learning materials from anywhere, and administrators can manage academic data accurately and centrally. This system not only enhances academic service quality but also sets a strong foundation for broader digital transformation in higher education institutions.

## 5. Conclusion and Recommendations

Based on the results of the analysis and the design of the web-based online examination system at the Faculty of Engineering, Universitas Jabal Ghafur, it can be concluded that the system provides an effective and efficient solution for digitalizing the examination process, which was previously conducted conventionally and required substantial resources and time. With its implementation, examinations can be fully administered online, supported by integrated learning modules that enable lecturers to upload materials and students to access them anytime and anywhere, creating a more flexible and accessible digital learning environment. Developed using the CodeIgniter framework, PHP, and MySQL, the system ensures flexibility for future development and maintenance. Its features encompass class management, course data, student and lecturer information, lecturer-class assignments, learning materials, question banks, exam scheduling, and user management, allowing administrators, lecturers, and students to manage and participate in examinations more efficiently and accurately. To support the system's long-term effectiveness, it should be fully utilized by the academic community, accompanied by training for operators, lecturers, and students to ensure proficient system use. Consistent maintenance of hardware and software is essential to uphold system performance and security, while strict protection of user accounts, including safeguarding passwords, is crucial to prevent unauthorized access and maintain the integrity of academic data.

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