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Web-based student Course Registration System (KRS) using the Extreme Programming (XP) method

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ABSTRACT

This research aims to design and develop a web-based Study Plan Card (KRS) system. The background of this study arises from challenges in the manual KRS process, which is time-consuming, prone to errors, and complicates information access. The development method employed is Extreme Programming (XP), which enables iterative system development and responsiveness to changing requirements. Data collection was conducted through observations, interviews, and document studies. The system was developed using PHP with the CodeIgniter 4 framework and MySQL database. The results indicate that the web-based KRS system enhances the efficiency of the KRS process, reduces data entry errors, and facilitates information access for students. Key features of the system include online KRS completion, digital signing by academic advisors, and integration with other academic information systems. System evaluation shows a significant improvement in data accuracy, accessibility, and information security. In conclusion, the implementation of this web-based KRS system successfully addresses issues in the manual KRS process, improves the quality of academic services, and provides an effective solution for KRS management.

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1. INTRODUCTION

Educational institutions are required to utilize digital processes to conduct academic activities efficiently and accurately(Castro Benavides et al., 2020). A web application is essential to provide access for students, lecturers, and institutional leaders. Monitoring and access to academic activities can be performed anytime and anywhere through mobile web applications (Jurnal et al., 2021). The Curriculum Card System is designed to manage academic data using technology, including both hardware and software. The purpose of this system is to transform academic activities into useful information for institutional management and to support decision-making by authorized parties. Additionally, this system aims to enhance the implementation of education, enabling institutions to deliver better and more effective information services (Halwa & Marwati, 2021).

One of the main issues identified is the manual process of creating the Study Plan Card (KRS). Students are required to fill out the KRS manually and seek their academic advisors (PA) for signatures. Subsequently, the Head of Study Program as Administrator needs to input the KRS data into the academic information system, adding complexity to course management. Delays in

KRS preparation by students represent a serious problem. Errors in KRS determination and delays in KRS adjustments are also significant challenges. Therefore, the implementation of the new KRS system is expected to reduce delays, errors, and difficulties faced by students in completing and managing their KRS. This system is designed with an emphasis on user-friendliness, data security, and the ability to provide real-time information. As a result, it is anticipated that the system will improve efficiency and effectiveness in KRS management.

Several studies have developed web-based Academic Information Systems (AIS) optimized for mobile device displays. For instance, research by (Biswas et al., 2020) demonstrated that mobile AIS applications could operate on Android versions 2.2 to 4.2. Similarly, (Dontre, 2021) applied Hybrid App and Webview concepts using the RAD methodology, resulting in a Mobile Web-based AIS for Android platforms with features such as student profiles, class schedules, study plan cards, and transcripts. Another study by (Febriyanto et al., 2020) on a web-based academic grading information system highlighted several features: user roles divided into five groups (students, parents, teachers, principals, and administrators), enabling each group to have specific access rights and responsibilities; web-based functionality allowing schools to monitor student attendance without relying on physical ledgers; internet accessibility for convenience; tools for parents to monitor their child's academic performance; and efficient data management for staff, parents, and students. Furthermore, (Esya Ardhana & Parga Zen, 2024) developed a web-based AIS for SMP NU Medan to manage processes like new student admissions, scheduling, attendance tracking, grading, and semester report card generation. This system also allowed parents to access academic information and monitor their child's progress easily. In general, Academic Information Systems, as defined by (Li et al., 2021) are computer-based systems designed to manage all academic activities in an educational institution. These systems integrate student data, faculty information, course schedules, grades, and other academic aspects, enabling more efficient and effective academic management.

Based on the identified issues and the literature review, the development of the proposed information system requires the use of Extreme Programming (XP), CodeIgniter, MySQL, Visual Studio Code (VS Code), and Figma to address the challenges effectively and ensure an optimal solution. The selection of Extreme Programming (XP) as the development methodology is motivated by its iterative and adaptive approach, allowing for active user involvement and continuous feedback. This ensures that the system meets the dynamic needs of students, academic advisors, and administrators while minimizing errors during development. CodeIgniter, a lightweight and powerful PHP framework, is chosen for its efficiency and simplicity in creating robust web applications, enabling rapid development of essential features such as KRS submission, approval, and integration with existing academic systems. MySQL is selected as the database management system due to its reliability, scalability, and compatibility with web applications, providing a secure and efficient platform for managing academic data. VS Code, as a versatile code editor, supports efficient coding, debugging, and collaboration among developers, streamlining the development process. Additionally, Figma is utilized as a design tool for its capability to create user-friendly and visually appealing interfaces while facilitating collaboration among stakeholders during the UI/UX design phase. These tools and methodologies collectively provide a comprehensive and effective framework for addressing the identified issues, ensuring the development of a secure, efficient, and user-centered academic information system.

Unlike prior research, the KRS system uniquely emphasizes solving specific university-level challenges in KRS management, incorporating feedback from diverse user groups (students, advisors, and administrators) and focusing on role-specific functionalities. The direct impact of implementing this system. For students, the system simplifies the process of creating and submitting their study plan cards, reducing delays and errors while providing real-time information on academic activities. For academic advisors and administrators, it minimizes manual tasks such as reviewing, signing, and inputting data.

Extreme Programming (XP) will be employed in the development process, featuring short and iterative development cycles. This approach allows active involvement from users (students and lecturers) throughout the development stages. Key features will be released incrementally and tested by users to ensure they meet the needs of students, lecturers, and administrators. User feedback will be utilized to make adjustments and improvements before the features are fully implemented. This XP approach is expected to enhance the acceptability and effectiveness of the Academic Information System (AIS) in the campus environment through intensive user

engagement and development tailored to user needs. The XP methodology, as described by (Kurniawan & Fauziah, 2023).

CodeIgniter, as noted by (Ismai, 2020), is a powerful PHP framework with a very small footprint. It is designed for developers requiring a simple yet elegant toolkit to build web applications with comprehensive features. Widely used for developing various applications, ranging from simple CRUD systems to more complex ones, CodeIgniter stands out among the numerous PHP frameworks available (Novaliendry & Putri, 2021). JavaScript, a programming language essential for creating interactive and dynamic web content, complements HTML and CSS to enhance user experience. According to JavaScript for Beginners (*JavaScript from Beginner to Professional: Learn JavaScript Quickly by ... - Laurence Lars Svekis, Maaike van Putten, Codestars By Rob Percival - Google Books*, n.d.), JavaScript enables developers to manipulate HTML elements, update web pages without reloading, and incorporate features such as animations, form validation, and DOM manipulation.

MySQL, one of the most popular open-source databases globally, ranks second after Oracle Database, according to DB-Engines. It is the database of choice for major applications accessed by millions, including Facebook, Twitter, Netflix, Uber, Airbnb, Shopify, and Booking.com (Tourbah, 2024). PHP, as a server-side scripting language, uses Composer to manage project dependencies efficiently. Composer simplifies coding processes by organizing libraries, frameworks, and other packages essential for PHP projects, while also facilitating maintenance and development (Vidal-Silva et al., 2020).

Visual Studio Code (VS Code) is a vital tool for enhancing development efficiency. (Del Sole, 2021) provides a comprehensive guide to configuring and customizing VS Code, helping developers fully utilize its capabilities through practical examples and real-world case studies. Unified Modeling Language (UML), a widely adopted standard modeling language, is instrumental in specifying system requirements, designing, analyzing, and visualizing architectural structures in object-oriented software development (Sunardi & Permana, 2024).

Figma is an open-source design tool commonly used for creating mobile application interfaces, desktop applications, websites, and more (Ibrahim et al., 2023). It is widely utilized by professionals in UI/UX design, web design, and related fields. Additionally, Figma supports collaborative work, allowing multiple users to work on the same project simultaneously (Suryani et al., 2023).

2. RESEARCH METHOD

The methodology for this research follows a structured sequence of steps to ensure systematic development. The process begins with Planning, where the project scope, objectives, and resources are outlined. This is followed by Interviews, The interviews involved 30 students from all levels, 5 academic advisors (Dosen PA), and 1 administrator, selected based on their direct involvement in the Kartu Rencana Studi (KRS) process. Simultaneously, a Documentation Study is Documentation studies were performed by analyzing existing academic processes, relevant references, and administrative workflows. Once the data is collected, the Data Analysis phase identifies patterns and extracts valuable insights to inform system design. The next step is Design, where the visual and functional aspects of the system are conceptualized. After the design is finalized, the Coding phase involves translating the design into functional code, followed by **Testing** to ensure the system operates as intended and meets user requirements. This methodology emphasizes a logical and iterative approach to achieving the research objectives effectively. Figure 1 illustrates the research methodology to be employed in this study.

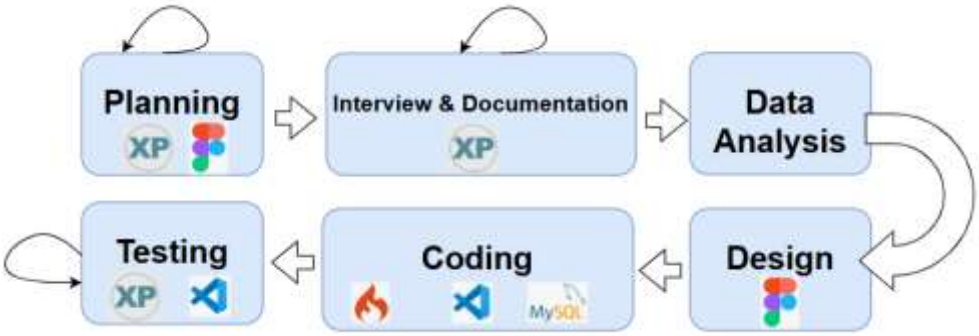

Figure 1. Research Methode

The proposed methodology integrates various tools and technologies to ensure the effective development of the academic information system. During the planning stage, the Extreme Programming (XP) methodology is employed to organize user stories, plan iterations, and engage users, including students, academic advisors, and administrators, in identifying system requirements. Initial user interface (UI) mockups are created using Figma to visualize design concepts based on user feedback. In the interview and documentation study stages, insights from user interviews and field observations are used to define and refine system requirements, allowing the iterative nature of XP to incorporate continuous updates. During data analysis, findings from earlier stages are translated into actionable design goals. The design phase relies heavily on Figma for creating detailed prototypes and user-friendly, visually appealing interfaces, with collaborative features enabling stakeholder involvement. The coding stage utilizes CodeIgniter as the PHP framework to build a secure and lightweight backend, while VS Code facilitates efficient coding, debugging, and collaboration. MySQL serves as the database management system, ensuring reliable and scalable storage and retrieval of academic data. In the testing phase, XP's emphasis on continuous testing ensures the system's reliability, with unit and user acceptance tests conducted iteratively. Tools like VS Code streamline debugging processes, allowing for the quick identification and resolution of issues. This integrated approach ensures a secure, efficient, and user-centered system development process. Regarding the selection of technologies, tools such as CodeIgniter, MySQL, and Figma were chosen not solely based on performance evaluations but also considering the research team's expertise with these technologies.

3. RESULTS AND DISCUSSIONS

The main focus of this section is to elaborate on the findings and evaluations from each stage of planning, as well as how the implementation of the proposed system addresses the identified needs and requirements.

3.1 UML Design Layout

A use case diagram is useful for formulating system requirements, verifying designs with clients, and creating test cases for each feature within the system. A use case can involve the functionality of other use cases as part of its workflow. It is generally assumed that the included use case will always be executed whenever the including use case runs normally. One use case can be included by several others, allowing the avoidance of functionality duplication by separating common functionalities. A use case represents the interaction between an actor and the system. An actor is a human or machine entity that interacts with the system to perform specific tasks. Figure 2 is the use case diagram used

Activity diagrams are used to illustrate the sequence of steps or activities carried out by actors and the system within a particular process (Tabrani et al., 2021) (Veza et al., 2022). In this system, various activities are performed by different stakeholders, including students, lecturers, administrators, system administrators, and finance personnel, each interacting with the system to fulfill their respective tasks (Malius et al., 2021). For example, students log into the system to fill out and submit their Course Registration Form (KRS) for approval. Lecturers review submitted KRS forms, approving or rejecting them based on academic guidelines. Administrators manage user

access, validate final KRS submissions, and oversee system configurations, while finance personnel confirm tuition payments and update the payment status in the system. These workflows are represented in activity diagrams, showcasing interactions, decision points, and outcomes. For instance, an activity diagram for the KRS process might depict the student logging in, completing the KRS, and submitting it, with branches showing whether the submission is approved or rejected by the lecturer. These diagrams, such as the one depicted in Figure 3, provide a clear visual representation of the processes, helping to identify areas for improvement and ensuring system efficiency.

A sequence diagram is a useful tool for illustrating the flow of interactions between actors (such as administrators, lecturers, and students) and the system across various business processes, including student data management, course registration (KRS) management, payment confirmation, and more (Hakim et al., 2020). This diagram aids in identifying the objects involved in each process and mapping the sequence of messages exchanged between them. By providing a detailed visualization of object interactions, sequence diagrams enhance understanding of the system's logic and workflow for both developers and other stakeholders. This clarity is especially valuable during the analysis and design phases of academic information systems, ensuring the system is effectively tailored to meet specific requirements, as illustrated in Figure 4.

A class diagram is used to represent the classes within the system being developed, in the form of objects. Each class in the class diagram has relationships with other classes (Rosca & Domingues, 2021). Every class in this diagram includes the class name, attributes, and operations that the class possesses. The relationships between classes, such as associations, generalizations, and dependencies, help define how the classes interact with each other within the system. This diagram is crucial for modeling the structure and behavior of the system, providing a clear view of the system's architecture and facilitating the development process, as illustrated in Figure 5.

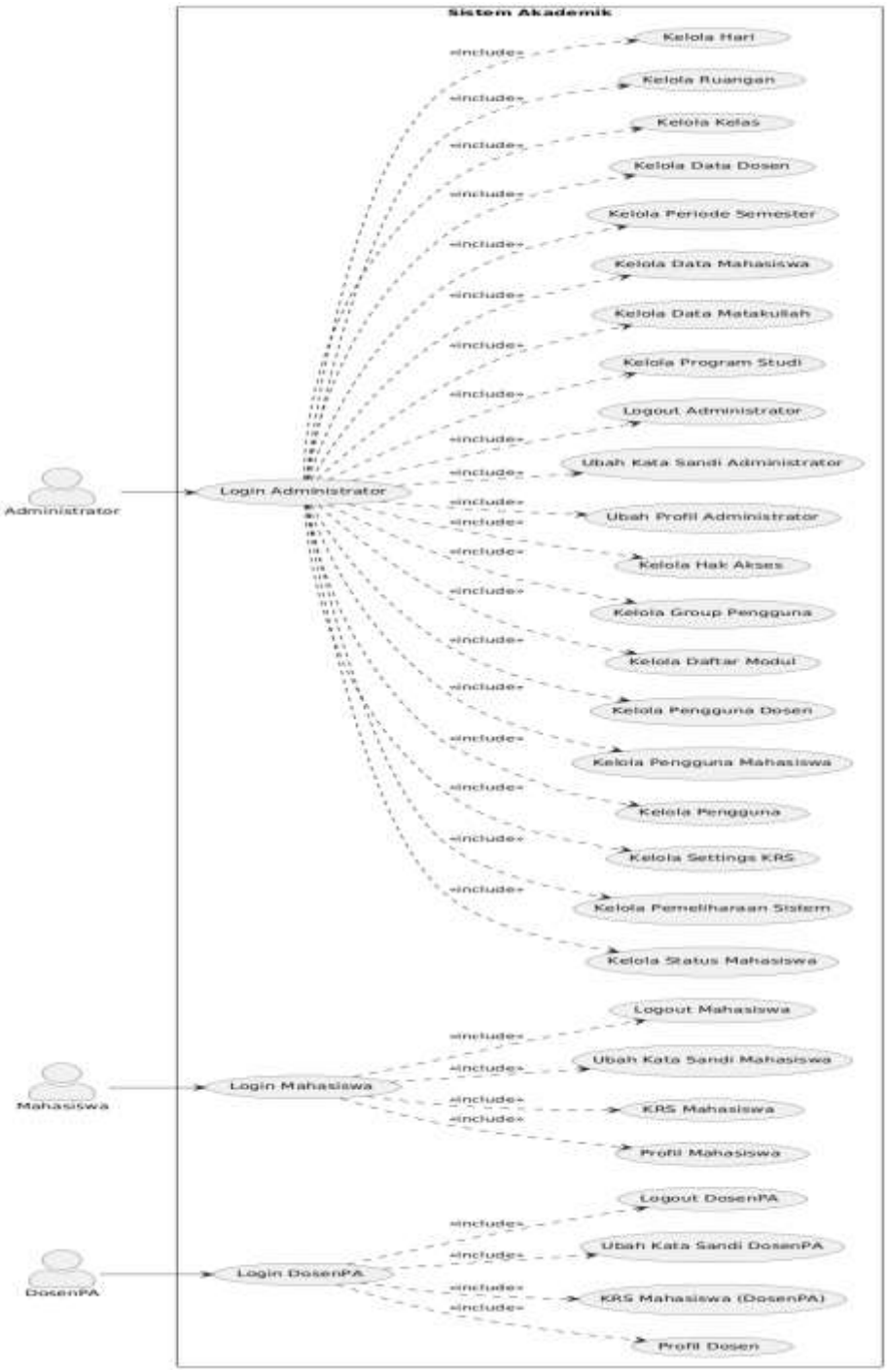

Figure 2. Use Case Diagram

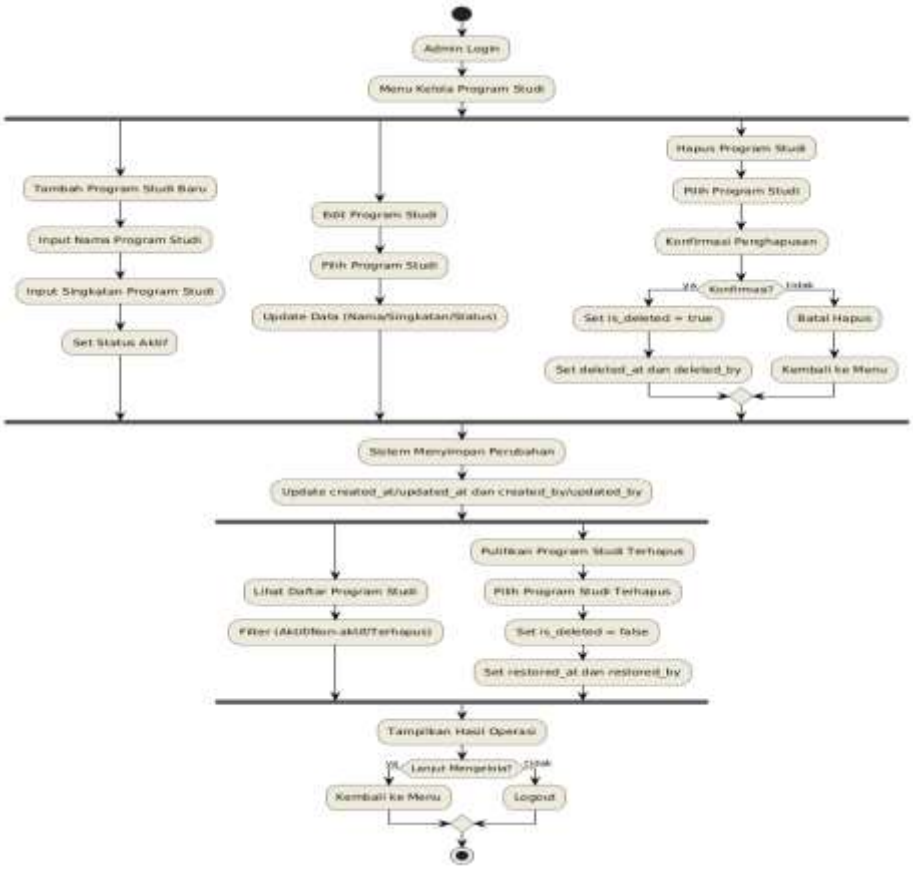

Figure 3. Activity Diagram

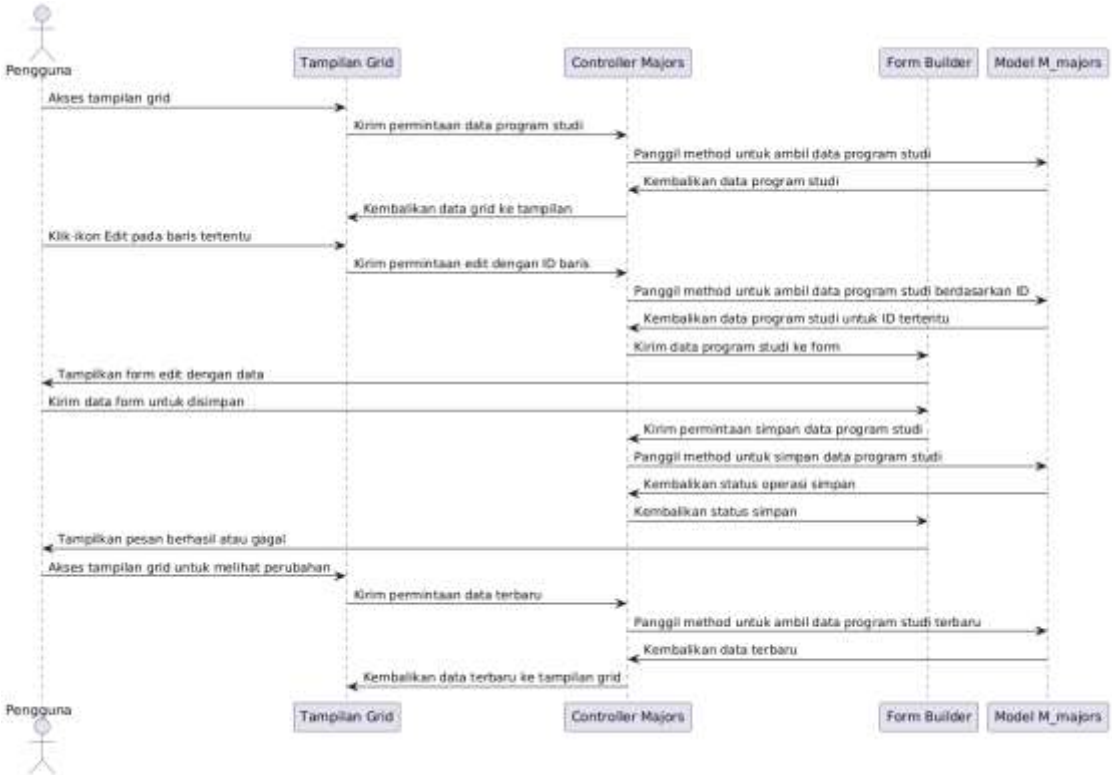

Figure 4. Squence Diagram

The class diagram illustrates the structure of the online KRS (Kartu Rencana Studi) management system, divided into several packages to organize the system components based on their functions. The User Management package handles system users, including students and lecturers. Academic Entities includes study programs, courses, and academic years, while People contain information about students and lecturers. The Class Management package oversees the classes and student placements, and Facilities manages rooms and resources. Finally, Academic Records handles the KRS and its organization. This organization helps define the flow and interactions between different aspects of the online KRS management system, ensuring an efficient and well-structured process.

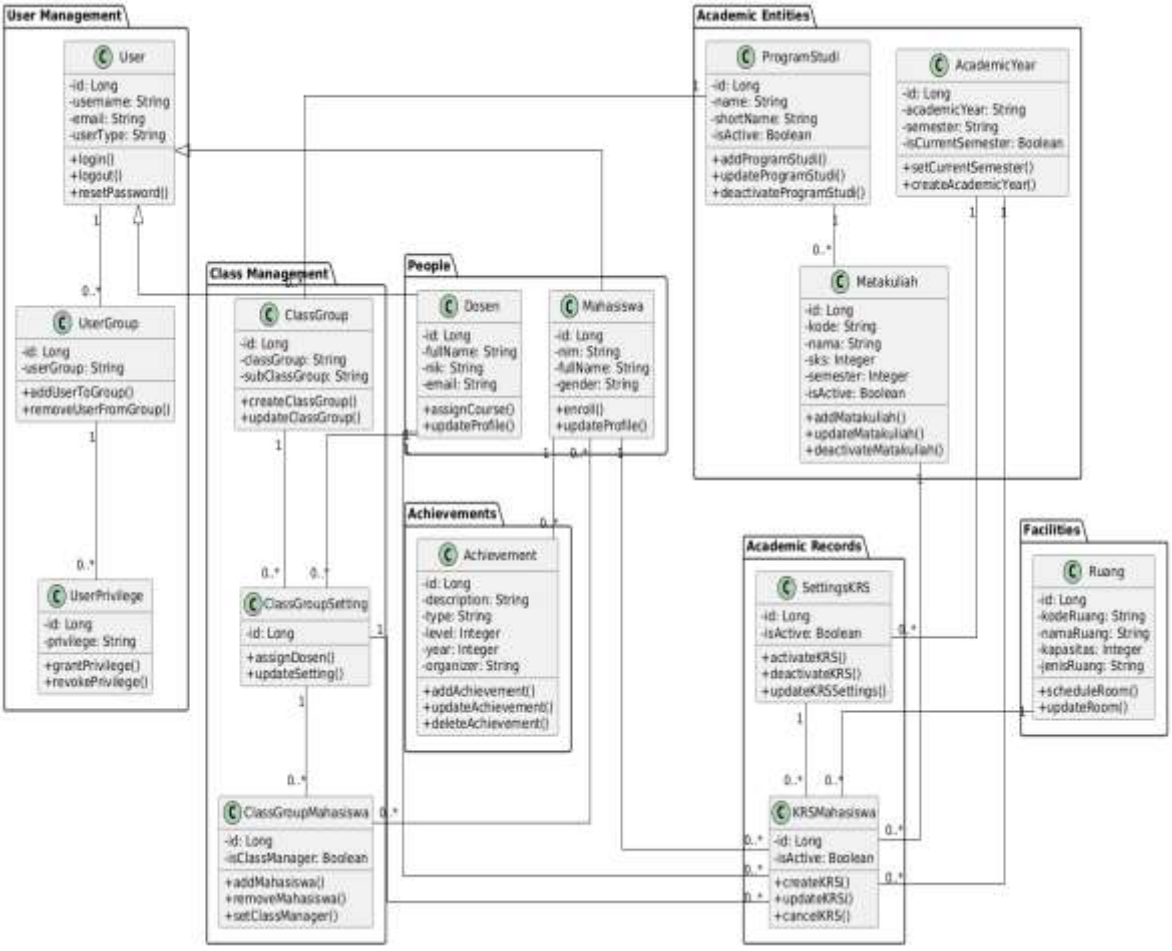

Figure 5. Class Diagram

3.2 Design Development/Implementation

The Figures 6 & 7 above shows the login page for the user and administration control. This page features a service title, two fields for entering the username and password, a "Log in" button to access the system, and a "Lost Excel" link that directs users to the page for recovering their password if forgotten. Additionally, the "Back to Tama Jagakarsa" link will redirect users to the institution Home Page. The Control Panel shown in the image serves as the administrative interface for managing various academic aspects at a higher education institution. One of the key features visible is the online KRS (Kartu Rencana Studi) management, which is a crucial component of academic administration. This KRS management involves several interconnected variables, accessible through the "Data Akademik" menu.

To effectively manage the KRS, the administrator must consider several important variables. These include the Study Program, which determines the curriculum and available courses; the Courses themselves, which are at the core of the KRS and influence students' eligibility to enroll in certain subjects. Other critical variables such as Classes, Rooms, Semester

Period, Students, Lecturers, and Days are also vital in creating the lecture schedules that will be included in the KRS.

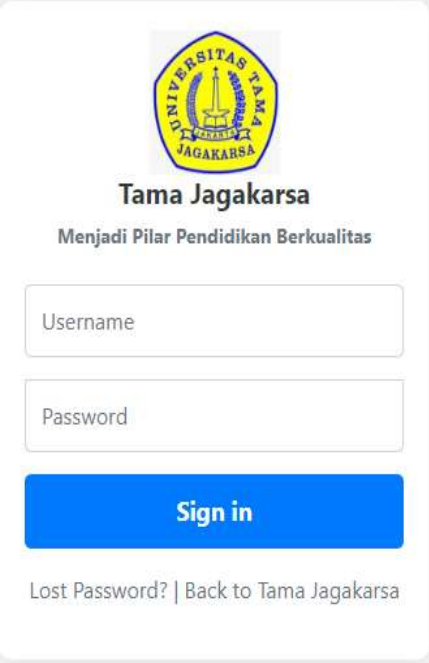

Figure 6. User login page

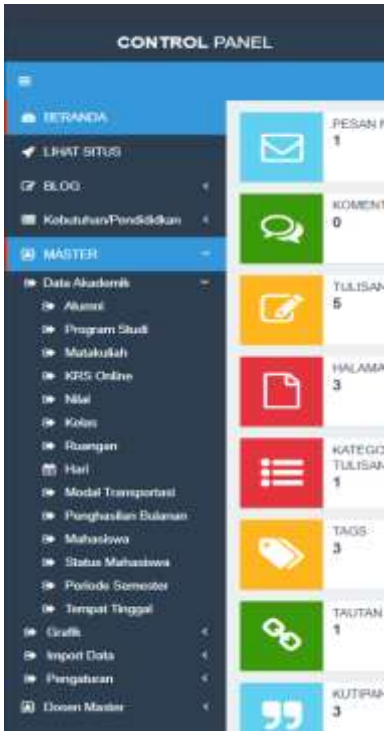

Figure 7. Admin Control Panel

3.3 Comprehensive Analysis of KRS System: Black Box Testing and User Feedback

The developed Kartu Rencana Studi (KRS) system is a crucial component in academic institution management. To ensure the effectiveness and quality of this system, a series of black box testing and feedback collection from various user groups have been conducted (Rambe et al., 2020). This comprehensive analysis aims to evaluate the system's performance from both a technical perspective and a user experience standpoint, as seen in Figure 8.

This section will present the results of black box testing, covering the system's functionality for three main user groups: administrators, students, and academic advisors (PA). Additionally, the analysis will include user feedback data obtained through surveys, providing insight into user perceptions and satisfaction levels with the system. By integrating quantitative data from the testing results with qualitative insights from user feedback, this analysis is expected to offer a comprehensive understanding of the system's strengths, as well as identify potential areas for further development and improvement. The findings from this analysis will serve as a crucial foundation for determining future optimization steps to enhance academic processes' efficiency and overall user satisfaction.

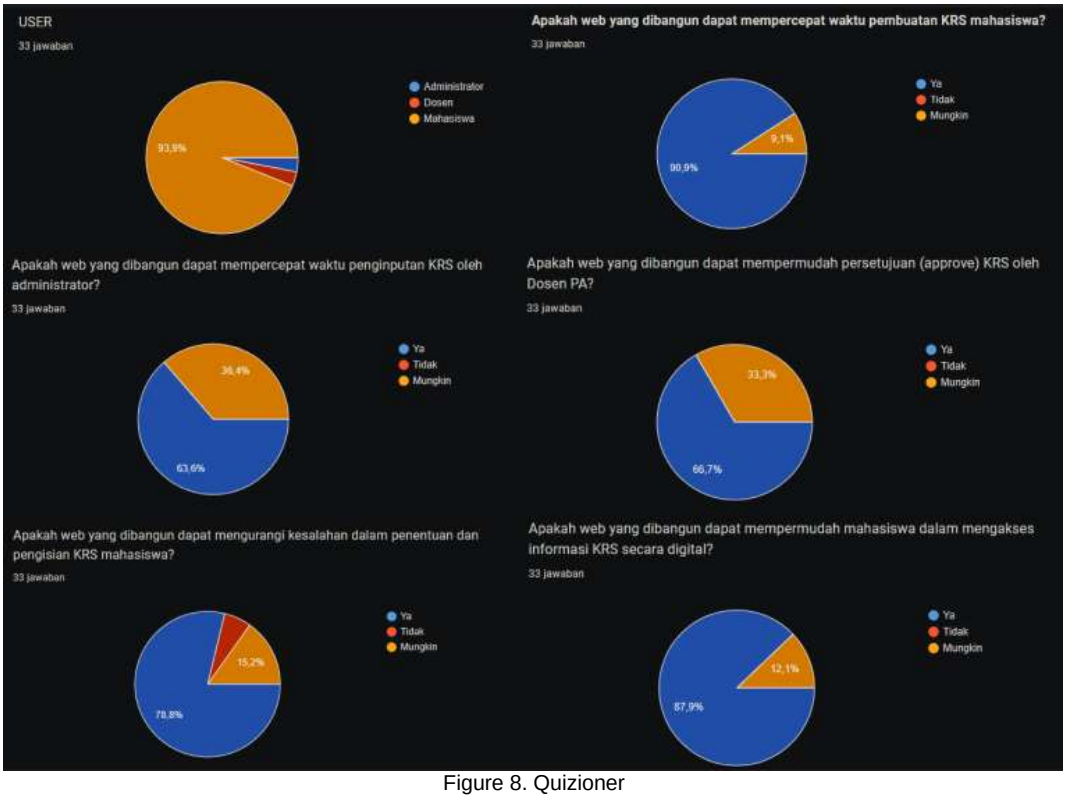

Figure 8. Quizioner

4. CONCLUSION

The developed Kartu Rencana Studi (KRS) system has proven essential for improving academic management at Universitas Tama Jagakarsa by enhancing efficiency and streamlining processes. The system could be further developed by integrating additional features, such as automated notifications, advanced reporting tools, or real-time data analytics, and incorporating new technologies like cloud-based solutions for better scalability and AI-driven recommendations for course planning. In terms of information security and accessibility, the system improves data protection through secure authentication mechanisms and role-based access control, ensuring that only authorized users can access specific features. Accessibility is enhanced by providing a user-friendly interface that is easy to navigate for students, administrators, and academic advisors. Metrics supporting these improvements include high user satisfaction ratings from surveys, minimal error reports during black box testing, and faster task completion times compared to the manual process. These enhancements solidify the system's role in supporting academic activities and providing a robust foundation for continuous improvement.

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