

## Optimizing Lean University Services Through UI/UX Design Using a User Centered Design Approach in Rokan Hulu

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**Abstrak:** Digital transformation in higher education demands efficient and user-centered digital service systems, particularly in regional universities where service processes are often fragmented, manual, and insufficiently aligned with user needs, such as in the context of Rokan Hulu. Existing studies predominantly address User Centered Design (UCD) or Lean Service separately, leaving a research gap in their integrated application for optimizing university digital services in developing regions. This study aims to bridge this gap by proposing an integrated UCD–Lean framework to redesign UI/UX and streamline service workflows based on empirical user needs and operational efficiency principles. The research adopts a four-stage UCD methodology consisting of context of use analysis through observations and semi-structured interviews with students, lecturers, and administrative staff; requirement specification using user personas and journey mapping; iterative design solutions developed through wireframes and interactive prototypes in Figma; and usability evaluation. Lean principles were operationalized through workflow simplification, elimination of non-value-added steps, and value-oriented interaction design. A purposive sample of 100 respondents representing primary academic service users in Rokan Hulu participated in usability testing using the System Usability Scale (SUS), selected for its reliability in prototype-level assessment. The results show a mean SUS score of 80 (“Good”), indicating acceptable usability and positive user acceptance, while the study theoretically contributes a contextual UCD–Lean integration model and positions its findings as preliminary usability evidence rather than definitive operational effectiveness due to prototype-based evaluation limitations.

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## INTRODUCTION

Digital transformation in higher education has been widely promoted as a strategic solution to improve academic and administrative service efficiency; however, empirical evidence indicates that many university digital systems remain fragmented, non-intuitive, and insufficiently aligned with actual user needs, particularly in regional institutions with hybrid manual–digital workflows (Bashir, 2024; Gonugunta & Leo, 2024). These conditions contribute to inefficiencies in academic and administrative services, creating suboptimal user experiences and hindering overall institutional performance.

Previous studies on UCD in higher education primarily focus on interface usability, navigation design, and user satisfaction, yet they often overlook underlying service process inefficiencies. Conversely, Lean Service research emphasizes workflow streamlining and waste reduction but frequently neglects user interaction and experiential usability dimensions. This indicates a conceptual and methodological fragmentation between usability-centered and process-centered research traditions (Thomson et al., 2019). As a result, universities often deploy systems that fail to reflect the actual needs, behaviors, and expectations of their primary users. This creates a mismatch between system design and practical conditions, ultimately reducing service effectiveness and user satisfaction.

A critical synthesis of prior research reveals that the integration of UCD and Lean principles remains largely conceptual, with limited empirical frameworks that operationalize both approaches simultaneously in higher education digital services (Rahman & Chairuddin, 2024). UCD principles has gained prominence as an effective approach for ensuring that digital solutions are developed based on a deep understanding of user characteristics and real-world usage contexts (Mirabdolah et al., 2023). UCD is defined as an iterative design methodology that positions users at the core of decision-making, involving them throughout all phases of design and evaluation to ensure usability, accessibility, and relevance (Velsen et al., 2022). When applied in higher education settings, UCD enables institutions to redesign complex service workflows, simplify digital interactions, and improve overall system usability (Yousif, 2025). Previous research has demonstrated that UCD can significantly enhance user experience and operational efficiency when combined with systematic assessment techniques such as usability testing (Putri, 2024; Visescu et al., 2025)

At the same time, Lean Service principles have been widely recognized as a practical framework for reducing non-value-added activities, streamlining processes, and improving organizational efficiency (Bhat et al., 2020; Marcelino et al., 2023). Lean thinking, originally developed in the manufacturing sector, has been successfully adapted to the higher education context, where administrative and academic services often suffer from redundancies, bureaucratic delays, and inconsistent workflows (Kakouris et al., 2022). Integrating Lean methodologies with UCD creates a complementary model: Lean reduces process waste, while UCD ensures that remaining processes are aligned with user needs (Ilyas et al., 2024; Spiridonova & Kaloshina, 2025). This synergy is particularly beneficial for universities in developing regions where resource limitations require solutions that are both efficient and user-focused (Aloudat et al., 2025; Lin et al., 2024).

Most existing studies either optimize interface usability without addressing service process waste or implement lean process redesign without validating user interaction quality. Consequently, there is insufficient evidence of an integrated UCD–Lean framework that simultaneously enhances usability and workflow efficiency in university service systems in regional institutions such as Universitas Pasir Pengaraian in Rokan Hulu—remain limited. Existing research tends to focus either on improving interface design or analyzing administrative process efficiency separately, leaving a gap in understanding how these two frameworks can be effectively combined to optimize digital services holistically. Furthermore, previous implementations often lack systematic user involvement and do not incorporate standardized usability metrics such as the System Usability Scale (SUS), which limits their empirical rigor and generalizability (Clark et al., 2021; Lu, 2025).

Therefore, this study aims to optimize Lean university services through a User Centered Design approach by designing and evaluating UI/UX interfaces tailored to the needs of academic communities in Rokan Hulu. The limitation becomes more significant in regional higher education institutions such

as those in Rokan Hulu, where digital service maturity, hybrid manual–digital workflows, and limited infrastructure readiness create unique constraints not sufficiently addressed in prior urban-centered studies. The research adopts an iterative UCD framework consisting of understanding the context of use, defining user requirements, producing design solutions, and conducting usability evaluations. By integrating Lean principles into UI/UX development, the study seeks to eliminate process inefficiencies while ensuring that the resulting system remains intuitive, accessible, and aligned with user expectations. The findings contribute to the literature by providing empirical evidence on the effectiveness of UCD-Lean integration for enhancing service quality, usability, and user satisfaction within higher education institutions in developing regions. This research also offers a practical model that can be adopted by similar institutions seeking to modernize their digital service ecosystems in a user-centered and resource-efficient manner.

**METHOD**

This study employs an integrated User Centered Design (UCD) and Lean Service framework as an analytically justified methodological approach to develop and evaluate a UI/UX prototype for university digital services in Rokan Hulu. UCD was selected not merely as a procedural design model, but as a user-driven methodology that enables iterative validation based on real user needs, service workflows, and institutional constraints in regional higher education. Lean Service principles were integrated to identify and reduce non–value-added activities in fragmented and partially manual service processes. Therefore, the methodology combines qualitative user analysis and quantitative usability evaluation, ensuring that the four UCD stages are implemented with analytical justification, contextual relevance, and measurable process simplification rather than purely procedural description (Pratama et al., 2024).

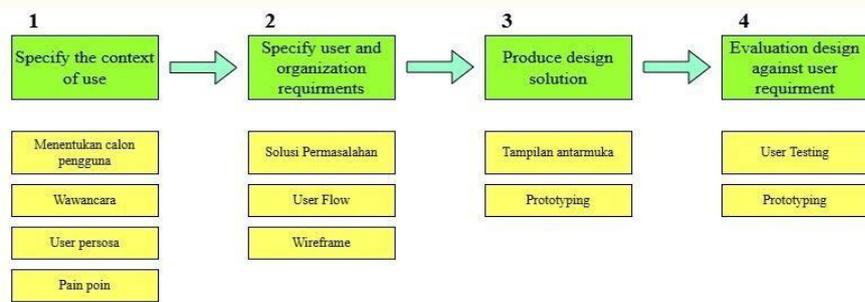


Figure 1. Metode User Centered Design

**Understanding the Context of Use**

The use of multiple data collection techniques was methodologically justified to ensure data triangulation and reduce bias in user need identification. Observations provided contextual insights into real service workflows, while interviews captured subjective user experiences and pain points. Workflow analysis complemented these findings by identifying operational inefficiencies in existing manual processes. This triangulated approach strengthened the validity of the context-of-use analysis and ensured that the design decisions were grounded in empirical user evidence rather than assumptions (Suja’I et al., 2019). This process enabled the researchers to define user profiles, operational contexts, device constraints, and pain points associated with current service processes. The outputs of this phase included user personas, user journey maps, and a comprehensive problem definition.

**Specifying User Requirements**

Based on insights obtained from the first phase, functional and non-functional requirements were systematically derived. Functional requirements included features necessary for service navigation, questionnaire submission, notification management, and administrative reporting. Non-functional

requirements encompassed usability, accessibility, efficiency, and system consistency. Requirements were validated through triangulation of interview data and stakeholder discussions. These requirements served as the foundation for subsequent interface and workflow designs.

### Producing Design Solutions

In the design phase, wireframes and interactive prototypes were developed using Figma to visualize and simulate user interactions. The design process followed iterative cycles, allowing stakeholders to review, comment on, and refine interface components. Lean Service principles were integrated into the design by simplifying workflows, eliminating redundant steps, and ensuring that each user action contributed directly to the value of the service being delivered. The prototypes included main screens such as login, service dashboard, questionnaire interface, notification page, and administrative reporting panel.

### Evaluating the Design

The final phase involved usability testing using a purposive sampling strategy to ensure the representativeness of primary university service users. A total of 100 participants were recruited, consisting of students, lecturers, and administrative staff who actively interact with academic and administrative services at Universitas Pasir Pengaraian in Rokan Hulu. The inclusion criteria required participants to (1) have prior experience using university service systems, (2) possess basic digital literacy, and (3) be willing to participate voluntarily in usability testing. Recruitment was conducted through institutional invitations and voluntary participation to minimize selection bias and ensure contextual relevance. Participant demographics were categorized based on user role, frequency of service usage, and level of digital familiarity to support more accurate usability interpretation. A total of 100 respondents representing target user groups participated in the testing by interacting with the prototypes and completing the SUS questionnaire. Each SUS item was rated on a 5-point Likert scale, and SUS scores were calculated following standard guidelines. The resulting average score of 80 indicated a “Good” usability rating, demonstrating that the proposed design met user expectations and improved overall usability compared to existing systems (Putra et al., 2025).

The formula using SUS:

Item Transformation Formula

$$S_{ij} = \begin{cases} x_{ij} - 1 & \text{if } j \text{ is odd} \\ 5 - x_{ij}' & \text{if } j \text{ is even} \end{cases} \quad (1)$$

SUS Score per Participant

$$S_i = \sum_{j=1}^{10} S_{ij} \quad (2)$$

$$SUS_i = S_i \times 2.5 \quad (3)$$

Overall SUS Score (Mean Score)

$$\overline{SUS} = \frac{1}{N} \sum_{i=1}^N SUS_i \quad (4)$$

### Ethical Considerations

All participants were informed about the objectives of the study and provided consent prior to data collection. The study ensured confidentiality and anonymity by not collecting identifiable personal data beyond what was necessary for analysis. Ethical guidelines for human-centered research were followed throughout the study.

### Methodological Contribution

In this stage, Lean Service principles were operationalized through measurable process improvement indicators rather than general design assumptions. The integration focused on (1) reduction of service steps compared to the existing manual workflow, (2) navigation flow simplification to minimize user cognitive load, (3) elimination of redundant data entry across service forms, and (4) identification of value-added and non-value-added activities within the university service process. A workflow comparison was conducted between the baseline manual service system and the proposed prototype to identify inefficiencies such as repetitive administrative procedures, delayed reporting, and

fragmented service access. The redesigned UI/UX prototype streamlined the interaction flow by consolidating service menus, reducing navigation layers, and providing centralized access to questionnaires and reports. This operationalization ensures that Lean implementation is not merely conceptual but analytically grounded in observable workflow simplification and process efficiency improvements within the context of university services in Rokan Hulu.

## RESULT AND DISCUSSIONS

The findings are not limited to interface presentation but focus on workflow efficiency, usability performance, and process simplification. The redesigned system reduces fragmented service access, minimizes redundant data entry, and streamlines navigation through a centralized dashboard, thereby decreasing non-value-added activities identified in the previous manual workflow. Usability outcomes, supported by SUS evaluation and user interaction observations, indicate improved task flow clarity and faster service completion. Thus, the results demonstrate that the integration of UCD and Lean principles contributes to both usability enhancement and operational efficiency, providing evidence-based validation of system performance rather than merely visual UI/UX improvements

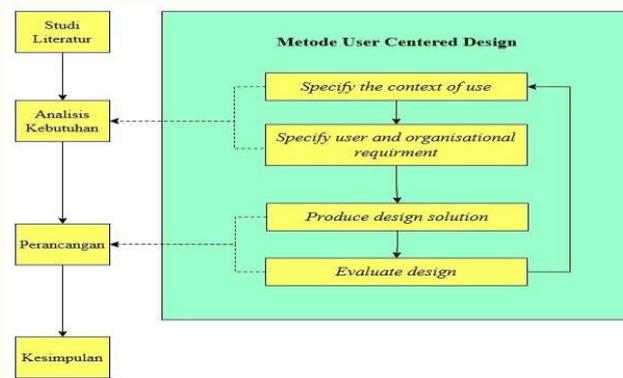


Figure 2. Flow Diagram Research

### Overview of the Research Procedure

The research procedure followed the User Centered Design (UCD) methodology, which is illustrated in the research flowchart (Figure 2). The framework ensured systematic involvement of users at every stage—from requirement identification to prototype evaluation. This approach enabled the development of a UI/UX model that aligned with user expectations, eliminated process inefficiencies, and supported Lean Service principles.

#### 1. Literature Study

The initial stage involved a comprehensive literature review to identify theoretical foundations related to User-Centered Design, Lean Service, and UI/UX principles in digital services. Previous studies were examined to understand best practices, methodological gaps, and the current state of research. This step established the research novelty by highlighting that limited empirical studies integrate UCD and Lean Service simultaneously in higher education service improvement.

#### 2. User and Organizational Requirements Analysis

User requirement analysis served as the core of the UCD methodology. Observations and interviews were conducted with students, lecturers, administrative staff, and service officers at Universitas Pasir Pengaraian. The analysis produced:

- a. User personas for both administrators and general users
- b. Pain points related to current manual processes
- c. User journeys that mapped interaction challenges
- d. Functional and non-functional requirements

The findings indicated common issues such as difficulty accessing services, ineffective manual data collection, slow administrative processes, and a lack of centralized service information. This validated the need for a digital, user-friendly, and efficient service system.

Table 1. User Persona Admin

| Category                                | Description  |
|---|--|
| Bio                                     | The service division at Universitas Pasir Pengaraian is responsible for managing and delivering services across several key areas within the university. These areas include administration, academic services, finance and payment, campus facilities, library services, and IT support.  |
| Needs                                   | <ul style="list-style-type: none"> <li>• Ability to manage and understand the service systems operating in each division of the university.</li> <li>• Provide an easier process for users to fill out questionnaires to evaluate ongoing services.</li> <li>• Access real-time reports generated from questionnaire responses.</li> <li>• Monitor and control all service systems to support faster and more efficient improvements.</li> </ul> |
| Pain Points                             | The university faces difficulties due to the absence of integrated digital service technology. As a result, manual reporting of service evaluation becomes time-consuming, error-prone, and inefficient. Additionally, there is limited knowledge and experience in designing systems that match user needs and can effectively solve current service-related issues.  |
| Expectations for the Future Application | Universitas Pasir Pengaraian expects the proposed UI/UX design to offer an attractive and user-friendly interface, making it easier for users to access the application comfortably. The design should also simplify the process of providing service evaluations and support user needs effectively.  |

Table 2. User Persona

| Category                                | Description  |
|---|--|
| Bio                                     | Users provide evaluations of the service system at Universitas Pasir Pengaraian through the Lean service application by completing the questionnaires available within the platform according to each service division.  |
| Needs                                   | <ul style="list-style-type: none"> <li>• Ability to view their user account profile.</li> <li>• Ability to fill out service questionnaires online for each service category at Universitas Pasir Pengaraian.</li> <li>• Ability to provide evaluations more easily and efficiently through the application.</li> </ul> |
| Pain Points                             | Users feel that the absence of digital technology makes it difficult to submit evaluations for existing services at Universitas Pasir Pengaraian. This lack of technology also slows down the improvement and enhancement processes needed to refine the service quality.  |
| Expectations for the Future Application | Users expect a design that aligns with their needs, making it easier to evaluate services at Universitas Pasir Pengaraian through a well-designed and user-friendly application interface.   |

### 3. Specify User Requirements

This stage involves identifying both user and organizational needs after conducting interview sessions with potential users. The focus is to determine appropriate solutions and address the problems users encounter when using the application, whether related to design or technical functionality. Solution to Identified Problems Based on the direct interviews conducted with users involved in this application (administrators, students, and lecturers), the following solutions were developed to address their needs and challenges:

Table 3. User Requirement

| User Type                             | Requirements   |
|---------------------------------------|--|
| Admin                                 | 1. Login: A login page for the administrator role to access the application. 2. Dashboard: A quick summary of survey results submitted by students or users, as well as available survey services. 3. Notifications: A page for viewing notifications sent by users and notifications regarding surveys completed by students or users. 4. Survey Records: Contains the recap or history of surveys submitted by students or users. 5. Profile: Displays the administrator’s personal information and allows editing of profile data.  |
| Students, Lecturers, Staff, Employees | 1. Login: A login page for users (students, lecturers, staff) to access the application. 2. Dashboard: A quick overview of survey results, such as average service satisfaction, total respondents, and graphical visualizations. 3. Survey Results: Ability to filter results based on service type and display average responses (e.g., strongly agree, agree, etc.). 4. Manage Questions: Ability to create, update, and delete survey questions (CRUD). 5. Response Data: List of students who have completed the survey (name, student ID, submission date). 6. Notifications: The ability to send announcements to students, such as <i>“The academic service survey is now open. Please complete it before September 20, 2025.”</i> 7. Reports: Ability to generate and print monthly survey reports. |

4. User flow

The outcomes depicted in this user flow represent the core operational processes within the university service application, demonstrating how users interact with the system from start to finish.

Table 4. User flow admin

| No. | User Flow Description  |
|-----|--|
| 1   | The administrator logs into the system to access the admin dashboard.  |
| 2   | The administrator can add or modify service-related data.  |
| 3   | The administrator can manage administrative service data.  |
| 4   | The administrator can manage payment-related administrative data.  |
| 5   | The administrator opens the report page to view and compile daily academic and administrative service summaries. |

The explanation below outlines the user flow for students as they interact with the university service application

Table 5. User Flow Student

| No. | User Flow Description   |
|-----|---|
| 1   | The student opens the university service application.                             |
| 2   | The student searches for the required service.                                    |
| 3   | The student registers for an account (if they are a new user).                    |
| 4   | The student logs in (if they already have an account).                            |
| 5   | The student logs in by entering their email, Student ID (NIM), and password.      |
| 6   | The student can view notifications sent by the administrator.                     |
| 7   | The student can upload supporting documents if needed.                            |
| 8   | The student can view detailed service request status on the Service History page. |
| 9   | The student logs out of the Lean university service application.                  |

## Wireframe

The design process was carried out using the Figma tool and adjusted according to user needs. The main page (home page) displays navigation menus such as Home, Notifications, Surveys, and Profile. Access to several services requires users to have an account. On the service catalog page, the system displays a list of services based on their respective categories. Meanwhile, the account page is used for student and lecturer registration and login, allowing them to easily access academic services

## Design Solution

Based on the results of the requirement analysis, this stage focuses on creating UI/UX design solutions through the development of wireframes and prototypes using tools such as Figma or Adobe XD. The UI design refers to principles of usability, accessibility, and alignment with local user preferences. The UX design emphasizes efficient and obstacle-free interaction flows in accordance with Lean principles, particularly minimizing non-value-added activities. The output of this stage is a UI/UX-based Lean service system prototype ready for testing. Design Evaluation. Evaluation is conducted to ensure that the prototype truly meets user needs and is efficient in terms of process flow. User testing is performed using methods such as usability testing and heuristic evaluation.

### 1. Produce Design Solution

This stage produces the design solution. Here, the designer develops the fundamental concept and creates the wireframe, which represents the initial structural layout of the application and involves user input.

### 2. Interface Design and Prototyping

Based on the previously developed wireframes, the next step is to create the prototype. The prototype serves as a simulation of how users interact with the Lean service application's UI in a real context. The prototype illustrates user interactions more concretely, enabling designers and stakeholders to evaluate usability, navigation flow, and interface clarity before moving to full system development.

#### a. Front Page Prototype

The front page (homepage) displays a list of available questionnaires for each service offered within the university. This page acts as the primary navigation point where users can easily access and select the service evaluation they wish to complete

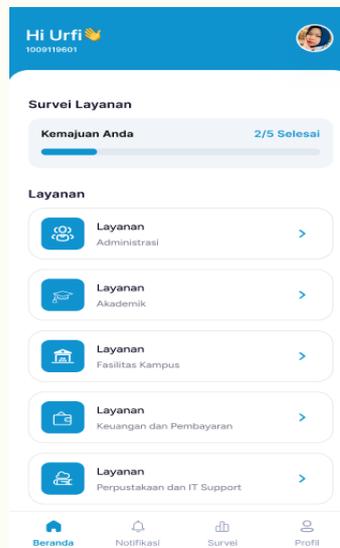


Figure 3. Front Page of the Lean Service Application

#### b. Login Page Prototype

This page serves as the account login interface for users who are already registered. It is essential for accessing the questionnaire used to evaluate the services provided in the Lean Service application.

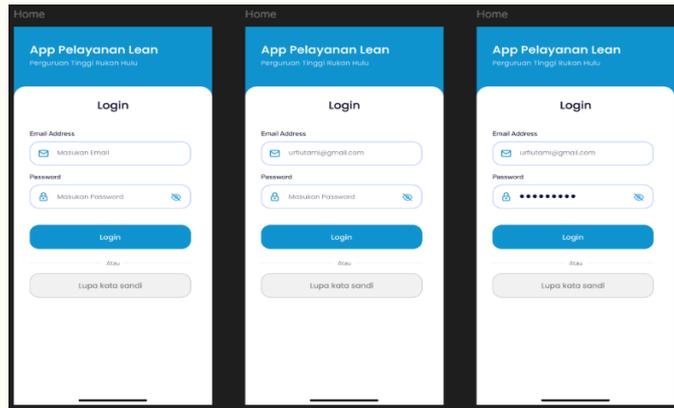


Figure 4. login lean

c. Prototype of the Sign-Up Page

This page serves as the account registration interface for new users, allowing them to create an account before accessing and completing service evaluation questionnaires. It also enables administrators to register and subsequently log in to the application to view and manage questionnaire reports.

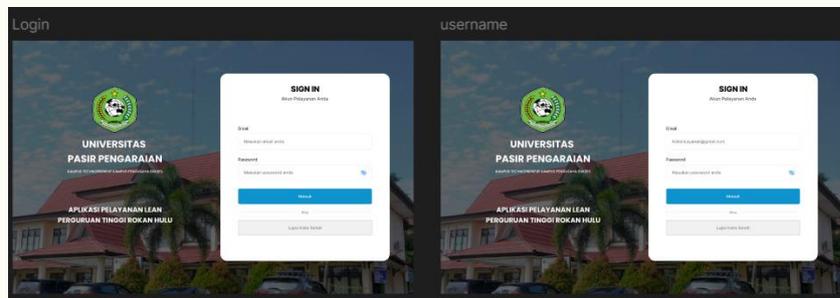


Figure 5. sign up

d. Submission Success Notification Page

This page indicates that the user's transaction has been successfully completed. It serves as an important confirmation for users and ensures that the submitted questionnaire results are properly recorded. The notification also supports validation and facilitates the reporting of survey responses to the admin dashboard.

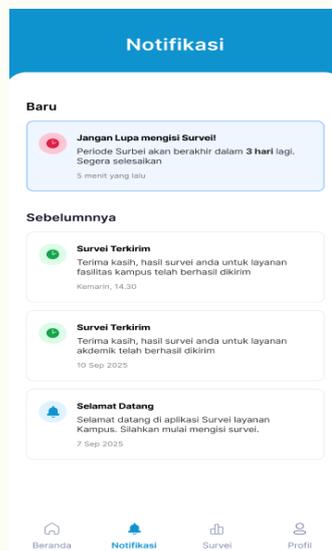


Figure 5. Notification lean

e. Survey Page

This page is used to display a recap of the questionnaire responses submitted for each service category. Users can also view detailed records of their previous answers. The interface provides a clear summary of response data, helping users track their participation in the Lean service evaluation process, as illustrated in the following figure.

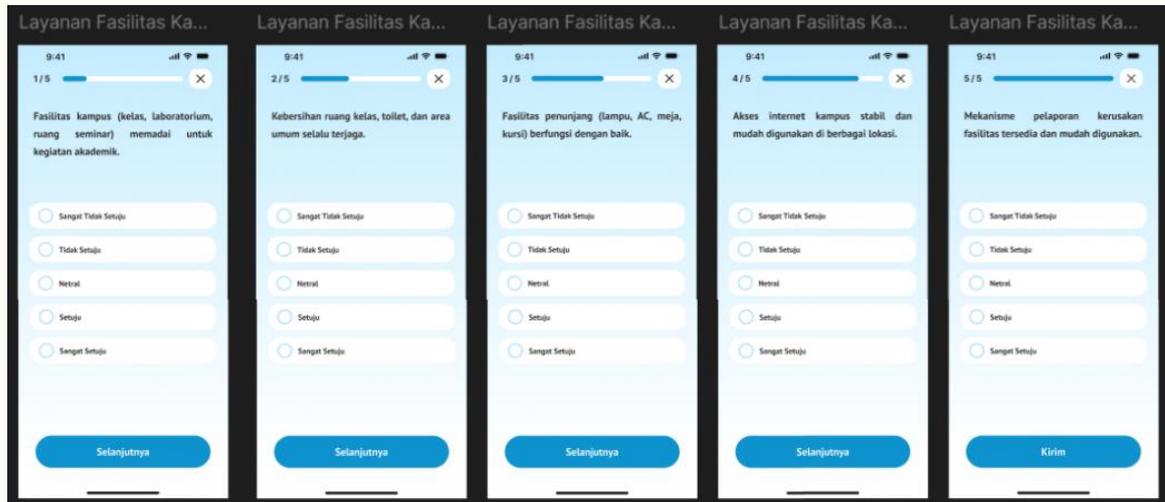


Figure 6. Services Campus

f. Profile Page

This page displays the account owner's personal information, including profile photo, student ID number (NIM), department, and password settings. It also provides configuration options and a logout button for users to securely exit their account

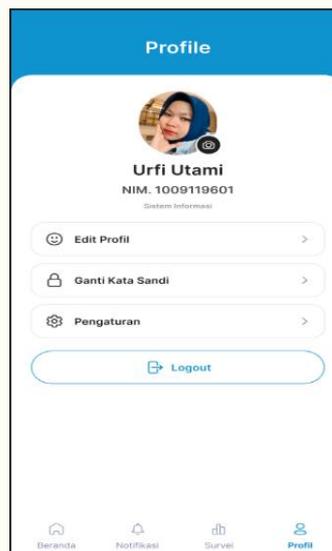


Figure 7. Profile Page of the Lean Service Application

g. Admin Dashboard Page

This page displays the main interface for administrators to manage survey results, user responses, notifications, and assessment reports for each service category. It serves as the central control panel where admins can monitor system activity, evaluate feedback, and oversee the overall performance of the lean service application

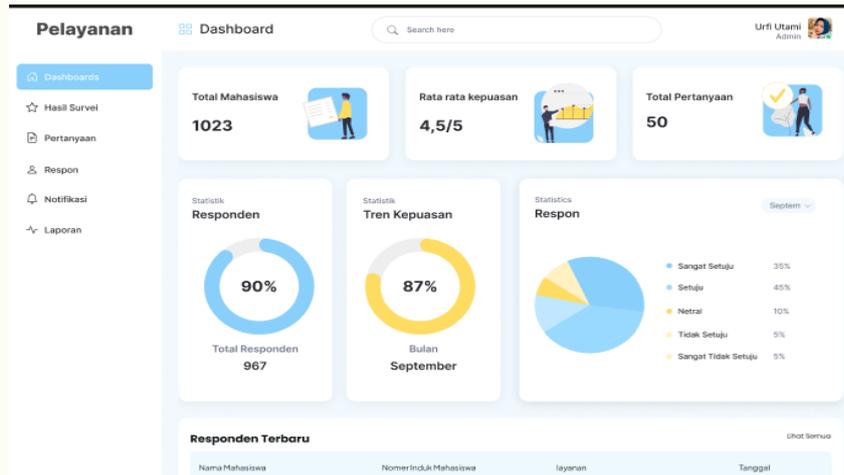


Figure 8. Admin Dashboard Page

**Evaluate Against Requirements**

The final stage focuses on evaluating whether the design is consistent with user requirements by testing the developed user interface prototype through usability testing. At this stage, an evaluation is conducted to determine how well the user interface design aligns with user needs and expectations. The assessment was carried out using the System Usability Scale (SUS) method, involving 100 respondents who served as potential users of the Lean service application at Universitas Pasir Pengaraian. After interacting with the UI prototype, respondents were asked to answer 10 questionnaire items based on their experience during testing. Each item used a Likert scale from 1 to 5, with the following descriptions.

- 1 = Strongly Disagree,
- 2 = Disagree,
- 3 = Neutral,
- 4 = Agree,
- 5 = Strongly Agree.

The SUS method was chosen because it provides a valid and reliable measurement of system usability. The list of questions used in the questionnaire is presented in the following table:

Table 6. SUS Review

| No | Question  | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|----|---|----|----|----|----|----|----|----|----|----|-----|
| 1  | I find the Lean service application interface easy to understand.                                   | 4  | 4  | 4  | 4  | 3  | 3  | 4  | 5  | 4  | 5   |
| 2  | I find the Lean service application complex and difficult to understand.                            | 2  | 2  | 2  | 1  | 2  | 3  | 2  | 3  | 1  | 3   |
| 3  | I feel that the Lean service application is well integrated.  | 4  | 3  | 4  | 1  | 4  | 4  | 4  | 3  | 2  | 3   |
| 4  | I feel that this application makes services more efficient and reduces processing time.             | 4  | 4  | 3  | 5  | 3  | 4  | 4  | 3  | 4  | 3   |
| 5  | I find it easy to fill out service questionnaires for each department.                              | 3  | 4  | 3  | 4  | 4  | 4  | 4  | 3  | 3  | 3   |
| 6  | I find the information displayed in the website interface difficult to understand.                  | 2  | 2  | 2  | 3  | 3  | 2  | 1  | 2  | 2  | 1   |
| 7  | I believe the interface of the Lean service application does not match its function and purpose.    | 1  | 2  | 2  | 2  | 1  | 1  | 2  | 2  | 1  | 1   |
| 8  | The menus and features in the application are well-structured and logical, making them easy to use. | 4  | 4  | 4  | 4  | 3  | 3  | 4  | 4  | 5  | 3   |

| No | Question  | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|----|---|----|----|----|----|----|----|----|----|----|-----|
| 9  | I feel that the service process in this application is faster than the manual method.         | 5  | 4  | 3  | 4  | 4  | 4  | 4  | 5  | 4  | 5   |
| 10 | I am satisfied and pleased with the overall experience of using the Lean service application. | 4  | 4  | 4  | 5  | 3  | 4  | 4  | 3  | 5  | 4   |

$$\overline{SUS} = 80$$

Based on established SUS benchmarks, a score of 80 falls under the “Good” category and indicates a high level of usability, efficiency, and user satisfaction. The score also places the system in the top usability percentile range, suggesting strong acceptance potential for real-world deployment

## CONCLUSIONS

Development of the Lean Service Application prototype successfully addressed the needs identified during the user requirement analysis stage through the integration of User Centered Design (UCD) and Lean Service principles. By employing iterative user-centered design and UI/UX prototyping tools such as Figma, the system was designed to enhance usability, streamline service workflows, and reduce unnecessary process steps for students, lecturers, staff, and administrators. The resulting prototype offers more intuitive navigation, simplified task flows, and clearer interfaces for survey submission and administrative monitoring, indicating alignment between user needs and functional design outcomes. The usability evaluation using the System Usability Scale (SUS) produced an average score of 80 (“Good”), suggesting that users were able to interact with the prototype effectively and with minimal difficulty. However, this result should be interpreted cautiously, as the evaluation was limited to short-term usability testing and does not yet reflect long-term operational performance or real-world system deployment. Despite the positive usability findings, the conclusion does not claim definitive effectiveness or large-scale feasibility. The assessment relied primarily on SUS without comparative testing against existing service systems, longitudinal evaluation, or comprehensive qualitative analysis, which limits the robustness of empirical validation. In addition, practical constraints such as infrastructure readiness, variability in user digital literacy, organizational resistance to system adoption, and scalability challenges may influence real implementation in a university environment such as Universitas Pasir Pengaraian. From a theoretical perspective, the study contributes by demonstrating a contextual integration of UCD and Lean Service for digital service optimization in regional higher education; however, the evidence remains prototype-based and exploratory rather than confirmatory. Therefore, while the proposed UI/UX design shows methodological feasibility and potential to improve service efficiency, future research should focus on backend system integration, security enhancement, comparative performance analysis, and longitudinal real-world deployment to strengthen empirical rigor, scalability, and generalizability of the proposed mode.

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