

Design Development of the JekNyong Application Using the Design Thinking Method

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Abstract

The JekNyong application is a platform that allows the people of Banyumas Regency to sell household waste for recycling. However, the application's user adoption rate remains low, with only 3.33% of families using it and a rating of 3.4 on the Google Play Store. This is due to an unintuitive interface design and limited feature accessibility. An initial usability test showed a task success rate of 75%, a time-based efficiency of 0.0206 goals/second, and a System Usability Scale (SUS) score of 63. The design development process followed the Design Thinking methodology through the stages of empathy, problem definition, ideation, prototyping, and testing. Several improvements were made to navigation, feature accessibility, and app layout. The second round of testing revealed significant improvements: the task success rate increased to 95.83%, time-based efficiency rose to 0.0382 goals/second, and the SUS score jumped to 86. These results indicate that the design improvements successfully enhanced the application's effectiveness and efficiency in accessing features.

Keywords: Application; Development; Design Thinking; System Usability Scale; Usability Testing

1. INTRODUCTION

Waste management is a crucial issue faced by various regions in Indonesia, including Banyumas Regency. Based on Law Number 18 of 2008 concerning Waste Management, the government is responsible for ensuring an efficient and environmentally friendly waste management system [1]. Banyumas Regency itself has demonstrated good performance in this regard, achieving a waste management rate of 99.31% in 2023 [2].

As part of these efforts, the Banyumas Regency Government launched the JekNyong application in 2021. This application aims to facilitate the community in selling household waste through a pickup system. However, the usage rate of this application remains low, with only about 3.33% of total households in Banyumas using it. Additionally, the JekNyong application's rating on the Google Play Store is only 3.4 out of 5 stars, lower compared to similar applications such as Salin (4.1) and Sapawarga (3.9).

A primary factor contributing to the limited adoption is the suboptimal user experience. Based on user reviews and findings from a pre-questionnaire survey [3], several issues were identified, including an unappealing user interface design, difficulty in accessing key features, and limitations within the digital payment system. These challenges reveal a significant gap between current application performance and user expectations for a more functional and user-friendly system.

To address these issues, usability testing is needed to identify the main problems experienced by users when interacting with the application. Usability testing is used to evaluate aspects such as learnability, efficiency, error prevention, and satisfaction, as well as to provide improvement recommendations based on data collected from user interactions with the application [4].

This research adopts the Design Thinking approach. The Design Thinking approach is a human-centered method that relies on intuition, pattern recognition, and the exploration of ideas that possess emotional and functional meaning [5]. This approach consists of five main stages: Empathize, Define, Ideate, Prototype, and Test. The Empathize stage aims to understand the user's perspective and needs through research and direct observation [6]. Next, the Define stage formulates the problem based on previous findings, producing a clear problem statement as a basis for solutions [7]. The Ideate stage focuses on exploring various innovative ideas without limitations, which are later narrowed down into final concepts [8]. Then, the Prototype stage allows the implementation of ideas into initial models that can be tested [9]. The test stage involves users evaluating the prototypes, gathering feedback, and refining the solutions to better meet user needs [10].

Several previous studies have applied the Design Thinking method in developing UI/UX for various applications. First, Perancangan UI/UX Prototype Aplikasi Dompot Digital Menggunakan Metode Design Thinking focused on improving the user interface and user experience in digital transactions, making them more efficient and easier to use [11]. Second, Perancangan UI/UX Fitur Customer Relationship Management (CRM) Pada Aplikasi ABC Reload Menggunakan Metode Design Thinking demonstrated how this approach can optimize CRM features to better meet business needs [12]. Third, Perancangan User Experience Aplikasi Online Market berbasis Mobile di Masa Pandemi menggunakan Metode Design Thinking highlighted how user-oriented UX/UI design can increase customer engagement during emergencies. Furthermore, the study UI/UX Redesign of SH-UPI App Using Design Thinking Framework proved the effectiveness of Design Thinking in improving accessibility and user experience [13].

The objective of this research is to redesign the user interface of the JekNyong application based on user needs and identified issues through the application of the Design Thinking methodology, as well as to improve the usability testing outcomes of the JekNyong application.

2. RESEARCH METHODOLOGY

This study commenced with an initial usability testing phase to evaluate user experience with the existing design of the JekNyong application and to identify emerging issues. Subsequently, the study implemented the Design Thinking methodology, which consists of five stages: Empathize to understand user needs, Define to formulate core problems, Ideate to generate solutions, Prototype to develop preliminary designs, and Test (Usability Testing) to evaluate the developed prototype. Upon completion of all stages, the study concluded with an analysis of the results and the formulation of conclusions. The overall research stages conducted in this study are illustrated in Figure 1.

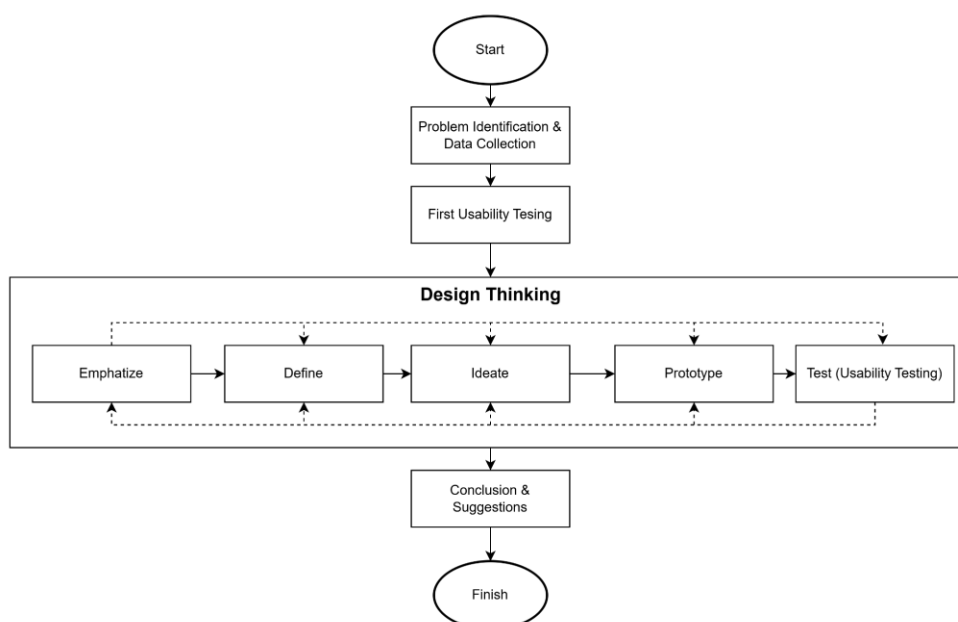


Figure 1. Research Stages

2.1 First Usability Testing

The usability testing in this study was conducted based on the ISO 9241-11 standard, which defines usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction [14]. This testing evaluated three primary aspects: effectiveness, efficiency, and satisfaction using the measurement parameters outlined in Table 1.

Table 1. Usability Testing Parameters

No	Aspect	Parameter
1	Effectiveness	Success Rate
2	Efficiency	Time-Based Efficiency, Overall Relative Efficiency
3	Satisfaction	System Usability Scale (SUS)

2.1.1 Effectiveness

Effectiveness refers to the degree to which users successfully and completely accomplish assigned tasks. Measurement was conducted using the success rate parameter, calculated using the following formula [15] :

$$\text{Success Rate} = \left(\frac{S + (P \times 0.5)}{\text{Total Task}} \right) \times 100\% \quad (1)$$

where:

S = Number of successfully completed tasks
P = Number of partially completed tasks
Total Task = Total number of tasks assigned

2.1.2 Efficiency

Efficiency pertains to the amount of effort and time required by users to complete tasks. Measurement employed two main parameters: time-based efficiency and overall relative efficiency, calculated as follows [16]:

$$\text{Time-Based Efficiency} = \frac{\sum_{j=1}^R \sum_{i=1}^N \frac{n_{ij}}{t_{ij}}}{NR} \quad (2)$$

$$\text{Overall Relative Efficiency} = \left(\frac{\sum_{j=1}^R \sum_{i=1}^N \frac{n_{ij} t_{ij}}{t_{ij}}}{\sum_{j=1}^R \sum_{i=1}^N \frac{n_{ij}}{t_{ij}}} \right) \times 100\% \quad (3)$$

Keterangan:

- N = Number of tasks
- R = Number of respondents/participants
- n_{ij} = Task completion result for task i by user j; if successful, $N_{ij} = 1$, if successful but through an unintended path, $N_{ij} = 0.5$, if failed, $N_{ij} = 0$
- t_{ij} = Time taken by user j to complete task i. If the task was not completed, the time was recorded until the user ceased attempting the task.

2.1.3 Satisfaction

Satisfaction refers to the degree of comfort and acceptance experienced by users toward the product. Satisfaction was assessed using the System Usability Scale (SUS) method [17]. The SUS is a questionnaire tool designed to evaluate the usability of a computer system from a user's subjective perspective. It can be applied to a wide range of products and services, including hardware, software, mobile devices, websites, and applications [18].

The SUS provides a score ranging from 0 to 100, comprising 10 subjective questions. Each question is rated using a five-point Likert scale: "Strongly Disagree (STS)" at the lowest level, "Disagree (TS)," "Neutral (R)," "Agree (S)," and "Strongly Agree (SS)" at the highest level. The classification parameters for interpreting the SUS scores are illustrated in Figure 2.

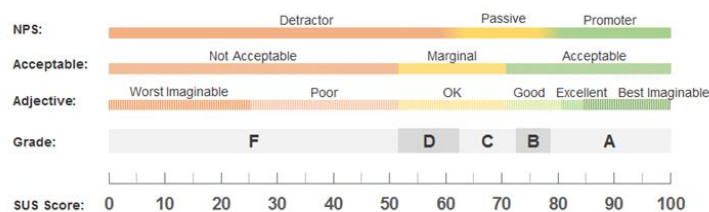


Figure 2. System Usability Scale Score Parameters [19]

Based on Figure 2, a higher SUS score reflects greater user satisfaction, while a lower SUS score indicates diminished satisfaction.

2.2 Emphasize

The first stage of the Design Thinking process involves developing a deep understanding and empathy for the problems that need to be addressed. This phase was accomplished through user research and direct observation. It also involved engaging prospective users to gain insights into their perspectives, thereby ensuring that the resulting solutions align with user expectations [6].

2.3 Define

Following the identification of user needs and challenges during the Empathize phase, the Define stage aims to clearly articulate the primary problems to be solved based on the collected data and insights. The output of this process is the formulation of concise and clear problem statements derived from observations during the Empathize phase [7]. By documenting and clearly defining the issues, it becomes easier to identify relevant solutions. Key deliverables in the Define phase include the development of user personas that represent user characteristics, needs, motivations, and behaviors. User personas help in determining the target audience for the application [20]. Additionally, affinity diagrams were created to categorize insights from the Empathize phase into understandable groups, and "How Might We" (HMW) questions were formulated to stimulate solution ideation.

2.4 Ideate

In the Ideate stage, ideas and solutions are generated based on the problems defined previously. Solution generation was guided by the HMW questions identified during the Define phase. This phase also involved the development of user flows for each solution, designed to help users easily navigate to their intended targets [11]. Following the creation of user flows, an information architecture was constructed to organize information in a manner that is more accessible and understandable for users [21].

2.4 Prototype

The Prototype stage involves implementing the ideas generated during the Ideate phase into tangible outputs [9]. Prototypes were developed based on the previously designed user flows and information architecture, depicting how users would interact with the application. The prototyping process produced designs using Figma, starting with wireframes to outline basic layouts. Subsequently, a design system was established to define component standards, followed by the creation of mockups or high-fidelity designs that closely resemble the final application appearance.

2.5 Test

In this final stage, a second round of usability testing was conducted using the improved application design, which had been refined based on participant feedback from the initial usability testing. The testing procedure mirrored the earlier usability assessment, enabling a comparison between pre- and post-redesign results obtained through the Design Thinking process.

3. RESULT AND DISCUSSION

3.1 First Usability Testing

In the usability testing phase, the JekNyong application was tested to gather usability parameters as well as to identify problems and difficulties faced by users when interacting with the application's features. The usability testing was conducted with six respondents who met the research criteria. The measured components included effectiveness, efficiency, and satisfaction.

3.1.1 Task Scenario

The task scenarios were designed to test the core features of the JekNyong application. The task scenarios used in this study are presented in Table 2.

Table 2. Task Scenarios for Usability Testing

Kode	Task Scenario	Scenario
TS1	Account Registration	You are a new user who has never used the JekNyong application. Please complete the registration process successfully.
TS2	Login to Account	You already have an account in the JekNyong application. Now, log in to your account to start using the application.
TS3	Sell Unsorted Waste (Anorganic)	You wish to sell unsorted anorganic waste. Please complete the waste selling process through the application.
TS4	Sell Sorted Waste	You have collected sorted plastic waste for sale. Please complete the process of selling the sorted waste through the application.
TS5	Withdraw Balance	You want to withdraw the balance available in your account. Please complete the withdrawal process.
TS6	Oleh-Olehe Nyong Marketplace Purchase	You wish to purchase a sweater from Sablon Kaos Purwokerto via the Oleh-Olehe Nyong marketplace. Please complete the purchase process.

3.1.2 Effectiveness Component

The effectiveness component measures the extent to which users successfully complete the assigned task scenarios during the testing phase. The success rates of participants during the first usability testing are presented in Table 3.

Table 3. Task Success Rates in the First Usability Testing

Kode	Success Level					
	TS1	TS2	TS3	TS4	TS5	TS6
P1	S	S	P	P	P	P
P2	S	S	P	P	P	S
P3	P	S	P	P	P	S
P4	S	S	S	S	P	P
P5	S	S	S	S	P	P
P6	S	S	S	P	P	P

Subsequently, the success rate was calculated using the success rate formula (1):

$$\begin{aligned}
 \text{Success Rate} &= \left(\frac{S + (P \times 0.5)}{\text{Total Task}} \right) \times 100\% \\
 &= \left(\frac{18 + (18 \times 0.5)}{36} \right) \times 100\% \\
 &= 75.00\%
 \end{aligned}$$

Based on the initial usability testing and the calculation results, the JekNyong application version 2.3.3 achieved a success rate of 75.00%. This result was influenced by the presence of 18 task scenarios that were categorized as partial success.

3.1.3 Efficiency Components

The efficiency component measures the amount of time required by users to complete each task scenario during the usability testing. Table 4 presents the calculation results for the efficiency component.

Table 4. Average Calculation of Efficiency Components

No	Task	Time Based Efficiency	Overall Relative Efficiency
1	Task 1	0,0219	91,79%
2	Task 2	0,0698	100,00%
3	Task 3	0,0087	70,71%
4	Task 4	0,0065	68,11%
5	Task 5	0,0070	50,00%
6	Task 6	0,0097	63,07%
Average		0,0206	73,95%

The obtained values were used as a benchmark to compare the initial and final testing outcomes. Through this comparison, it can be determined whether users' speed in utilizing features and finding necessary information within the JekNyong application improved or declined.

3.1.4 Satisfaction Components

The satisfaction component assesses the users' level of satisfaction when interacting with the application. This measurement utilized the System Usability Scale (SUS) questionnaire, which was distributed to the participants after the usability testing. Table 5 shows the results of the SUS calculations for the first test.

Table 5. First SUS Score Results

Respondent	Score Result										Total	SUS
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		
P1	3	3	2	3	2	1	3	3	3	1	24	60
P2	4	3	3	1	1	0	3	4	3	2	24	60
P3	3	3	4	3	3	1	3	2	3	1	26	65
P4	3	2	2	4	3	3	2	1	2	1	23	58
P5	3	3	2	3	2	4	3	2	3	2	27	68
P6	3	4	3	2	4	3	3	2	3	1	28	70
Average Score (SUS)												63

Based on the satisfaction component calculations shown in Table 5, the SUS score obtained was 63. This score falls within the marginal acceptability range, corresponds to a grade scale of D, and is rated as OK on the adjective rating scale. These results indicate that user satisfaction with the application is relatively low.

3.2 Emphatize

At the empathize stage, an evaluation was conducted on the initial design of the JekNyong application. The testing results revealed various usability issues that caused discomfort and difficulties for users when interacting with the application. Therefore, further actions were deemed necessary to improve features that were identified as difficult to use.

3.3 Define

At this stage, define the information that has been obtained by producing user personas and how might we questions.

3.3.1 User Persona

To gain a deeper understanding of the characteristics of JekNyong application users, a user persona was developed based on data collected from participants and actual users. This user persona helps identify the users' needs, behaviors, goals, and main pain points, thereby serving as a foundation for designing more relevant solutions. Figure 3 shows the user persona of the JekNyong application user.



Figure 3. User Persona of JekNyong Application

Figure 3 illustrates the user persona representing the primary users of the JekNyong application. The persona includes demographic information, user needs, motivations, and challenges encountered while interacting with the application. The data were obtained during the empathize phase through observations and usability testing. This user persona serves as a critical reference for guiding the development of user-centered solutions.

3.3.2 How Might We Questions

After identifying the key problems during the empathize and define stages, a series of How Might We (HMW) questions were formulated. These questions aim to transform identified problems into opportunities for innovation and solution development for the JekNyong application. Figure 4 show the questions that have been generated based on the problem statements found..

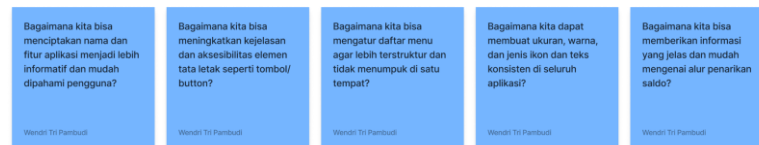


Figure 4. How Might We (HMW) Questions

Figure 4 presents the formulated How Might We (HMW) questions based on the previously identified problems. The questions are categorized to address specific aspects such as improving navigation, facilitating transactions, and enhancing user convenience. This set of HMW questions serves as the foundation for the subsequent brainstorming sessions during the ideate phase.

3.4 Ideate

In the ideate stage, brainstorming sessions were conducted to generate a wide range of creative ideas that could serve as potential solutions to the previously defined problems. The outcomes of this stage include How Might We solutions, a user flow diagram, and an information architecture structure for the JekNyong application.

3.4.1 How Might We Solutions

Following the formulation of the How Might We questions, the brainstorming process was carried out to explore various ideas that could address these questions. Each solution aims to improve the overall usability and user experience of the application interface as seen in figure 5.

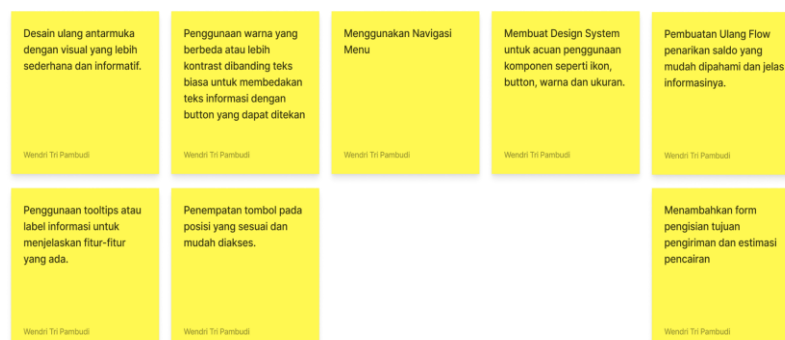


Figure 5. How Might We Solutions

Figure 5 depicts the solutions generated through brainstorming activities in response to the How Might We questions. The proposed ideas cover several approaches, including enhancing navigation efficiency, streamlining transaction processes, and improving user satisfaction. These solutions serve as a critical input for the subsequent development of the user flow and prototype design of the application.

3.4.2 User Flow

To visualize the user's journey in accomplishing specific tasks or utilizing features within the JekNyong application, a user flow diagram was developed. The user flow of the JekNyong application is presented in Figure 6.

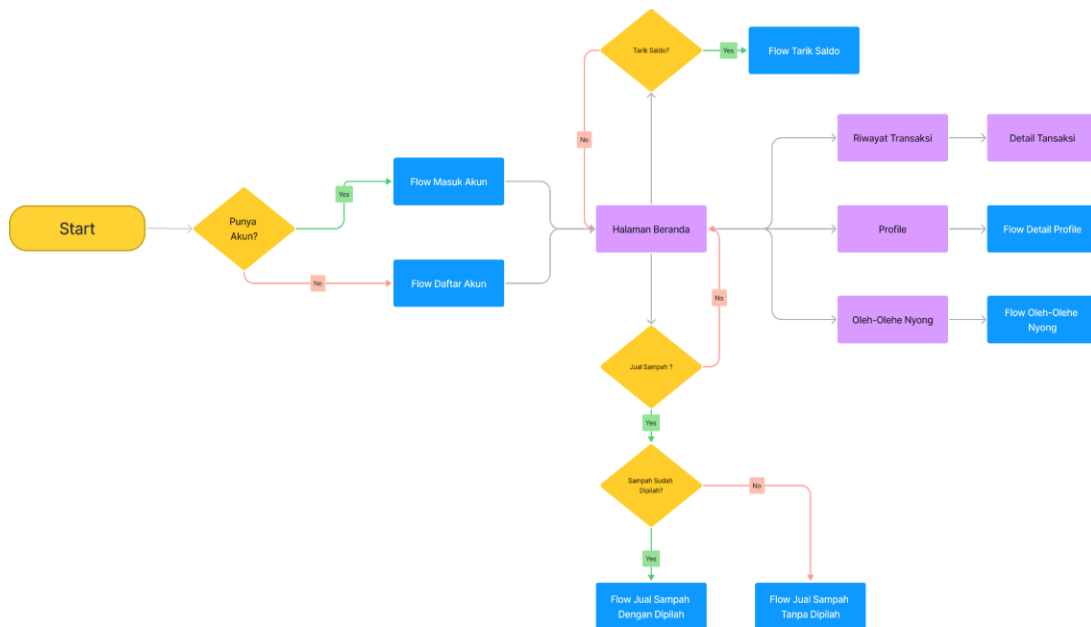


Figure 6. User Flow of the JekNyong Application

Figure 6 illustrates the sequence of steps that users take when performing actions such as account registration, selling waste, withdrawing balances, and purchasing from the marketplace. This user flow helps identify potential pain points and ensures a seamless and intuitive user experience across the application.

3.4.3 Information Architecture

The organization of content and features within the JekNyong application was systematically structured through information architecture design. The information architecture developed for the JekNyong application is shown in Figure 7.



Figure 7. Information Architecture of the JekNyong Application

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3.5.3 High Fidelity

The high-fidelity design phase focuses on developing detailed user interface prototypes for the JekNyong application based on the core features identified during the ideation and prototyping stages. These high-fidelity screens aim to improve clarity, usability, and the overall user experience. The designs are divided into six primary features of the application, each presented and explained below.

a. Account Registration

This feature provides the flow for users to register a new account in the application. The design separates the data entry process into two steps: account information and personal information forms. This segmentation aims to enhance clarity and reduce cognitive load during the registration process. Figure 10 illustrates the high-fidelity interface for the account registration feature.

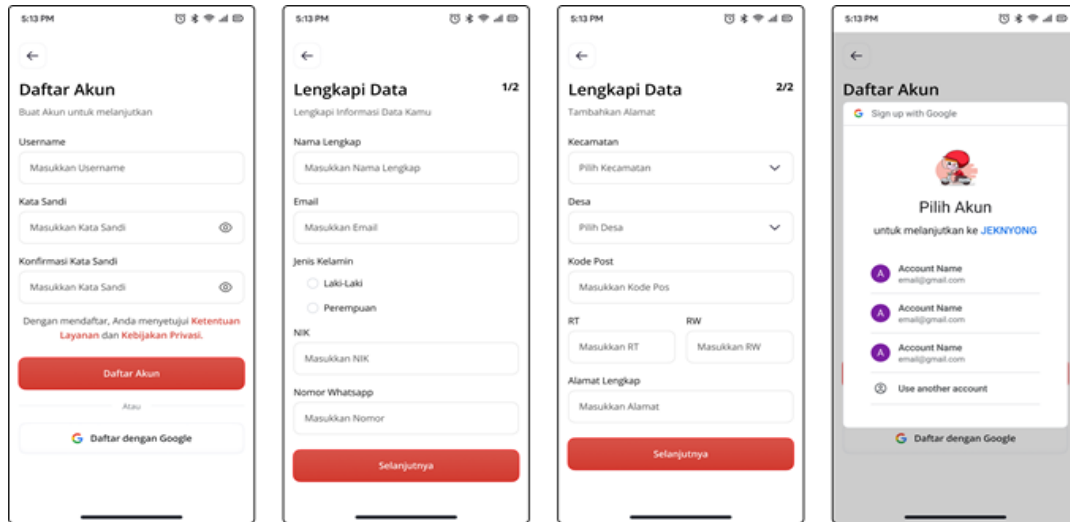


Figure 10. High Fidelity Account Registration

b. Login / Sign In

This is the initial page displayed when users open the JekNyong application. To access other features, users must log in with their credentials. The high-fidelity design focuses on a clean and intuitive layout to streamline the login process. Figure 11 shows the high-fidelity design of the login feature.

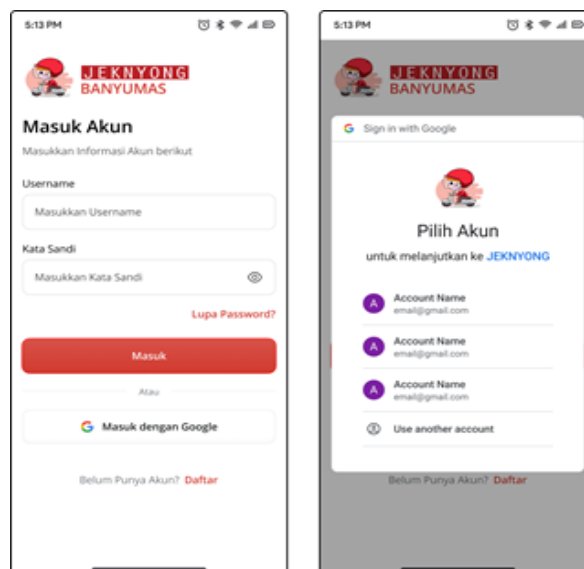


Figure 11. High Fidelity Login / Sign In

c. Sell Non-Sorted Waste

This feature enables users to sell inorganic waste, regardless of whether it has been sorted. The new design introduces clear distinctions on the waste selection screen and a reorganized structure for the sales form to simplify the input process. The updated high-fidelity layout for this feature is presented in Figure 12.

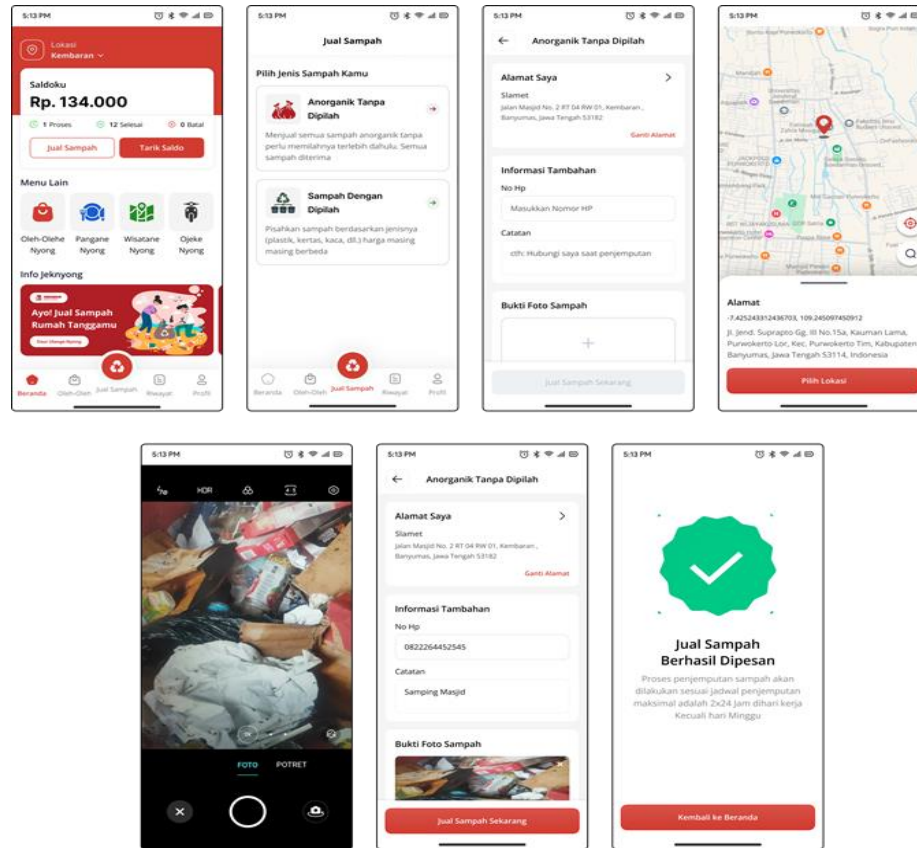


Figure 12. High Fidelity Sell Non-Sorted Waste

d. Sell Sorted Waste

Users can utilize this feature to sell pre-sorted waste. Enhancements include additional information on the waste selection screen and descriptive labels for each waste type to help users make informed choices. Figure 13 depicts the high fidelity design for the sorted waste selling feature.

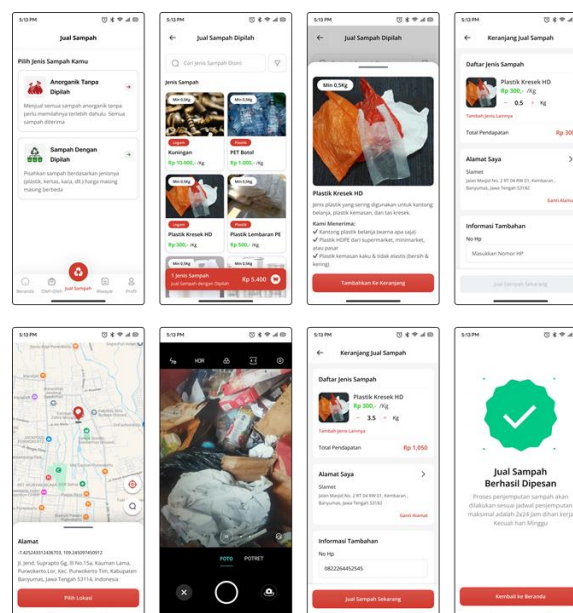


Figure 13. High Fidelity Sell Sorted Waste

e. Withdraw Balance

This feature allows users to transfer their accumulated balance to a designated bank account or digital wallet. The updated interface includes new input fields for entering financial details, designed for better usability and clarity. The high-fidelity interface for the balance withdrawal feature is showed in Figure 14.

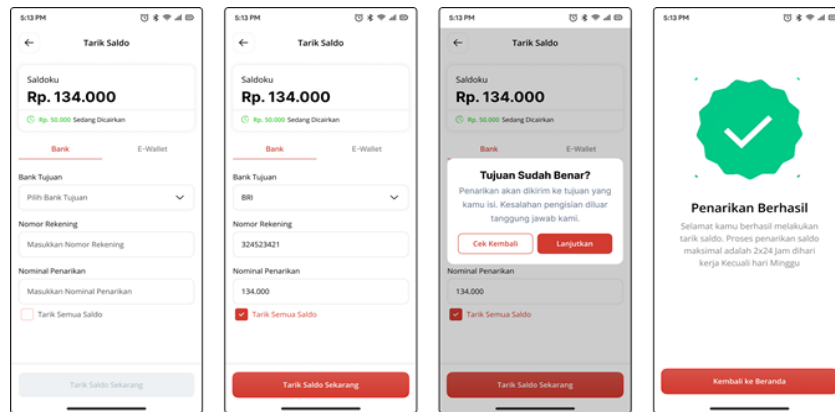


Figure 14. High-Fidelity Withdraw Balance

f. Oleh-Olehe Nyong (Local Products Marketplace)

The Oleh-Olehe Nyong feature enables users to purchase local MSME (Micro, Small, and Medium Enterprises) products from Banyumas. The improved design introduces a more structured homepage with product categories and store recommendations, allowing users to browse and shop more efficiently. Figure 15 presents the high-fidelity design for the Oleh-Olehe Nyong feature.

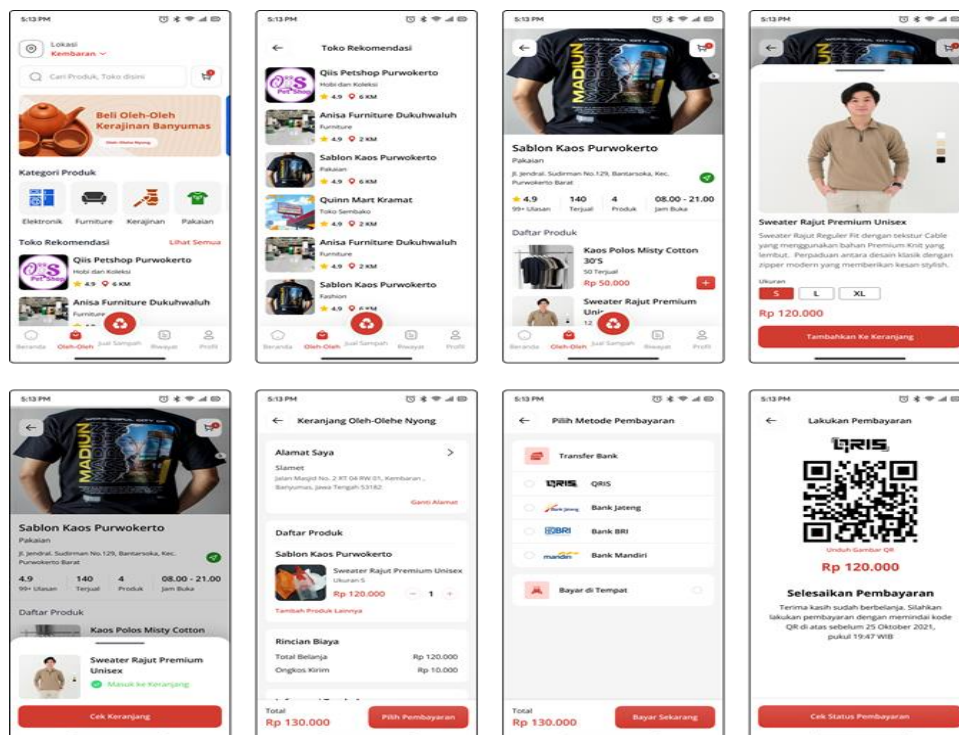


Figure 15. High-Fidelity Oleh-Olehe Nyong

3.6 Test

At this stage, the second usability testing was conducted on the redesigned JekNyong application, developed through the design thinking process. The test involved the same six participants as the first usability evaluation. The comparison results between the first and second usability testing are presented in Table 6.

Table 6. Comparison Between First and Second Usability Testing

	First Testing	Second Testing
Effectiveness	Success Rate = 75.00%	Success Rate = 95.83%
Efficiency	TBE = 0,0206 goals/sec ORE = 73,95%	TBE = 0,0382 goals/sec ORE = 95,64%
Satisfaction	SUS Score = 63	SUS Score = 86

Table 6 shows significant improvements in all three aspects of usability after the application redesign. The task completion success rate increased from 75.00% to 95.83%, indicating improved effectiveness. Time-based efficiency (TBE) increased from 0.0206 to 0.0382 goals per second, and overall relative efficiency (ORE) increased from 73.95%

to 95.64%, reflecting faster task execution. In addition, user satisfaction, as measured by the System Usability Scale (SUS), increased from a score of 63 to 86, indicating a shift from a marginal usability rating to an excellent usability rating.

4. CONCLUSION

The usability testing results before and after the redesign of the JekNyong application demonstrated notable improvements. In the initial evaluation, the task success rate was 75%, with an average time-based efficiency of 0.0206 goals per second and an overall relative efficiency of 73.95%. The mean System Usability Scale (SUS) score was 63. Following the design enhancements, the task success rate increased to 95.83%, the time-based efficiency improved to 0.0382 goals per second, and the overall relative efficiency reached 95.64%. The SUS score rose to 86. These findings confirm that the design development of the JekNyong application, guided by the design thinking methodology, effectively and efficiently improved the application's usability, as evidenced by the enhanced performance across all usability testing indicators.

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