Jurnal Teknik Informatika (JUTIF)
Vol. 5, No. 4, August 2024, pp. 723-733

DOI: https://doi.org/10.52436/1.jutif.2024.5.4.2140
p-ISSN: 2723-3863
e-ISSN: 2723-3871

ANALYSIS AND REDESIGN OF SI TOYA WENING APPLICATION USING DESIGN THINKING METHOD

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(Article received: May 27, 2024; Revision: June 14, 2024; published: September 01, 2024)

Abstract

Si Toya Wening application is an application designed to facilitate Surakarta PDAM customers in making water bill payments, making complaints, and other features. When research was conducted to 155 users, it showed that there were several indications of problems that usability in this application was not going well, such as a less intuitive interface, mismatch of items on the bottom navigation bar, and information blocked by other elements. In order to enhance the usability of this application, redesigning the interface is essential. As a measure of success, usability testing and system usability scale were used to compare the initial appearance and the appearance after being redesigned. The result of this research is a redesigned prototype with the design thinking method which is then tested using SUS to a sample of 83 respondents. SUS parameters are Acceptability ranges, adjective ratings, and grade scale. The final test results will be assessed in comparison to the initial test results. The test results show a significant improvement in application usability. The increase in the SUS score from 62.35 in the first test to 80.69 in the final test shows an improvement in usability. The acceptability range shifted from "MARGINAL LOW" to "ACCEPTABLE," the adjective ratings improved from "OK" to "EXCELLENT," and the grade scale rose from category "D" to "B." This enhancement indicates that the application's usability has significantly improved.

Keywords: *Design Thinking, Interface Redesign, System Usability Scale, Usability Testing.*

1. INTRODUCTION

The advancement of science and technology in modern times has a significant influence on societal trends in a variety of everyday activities[1].One part of the implementation of information and communication technology is a mobile application that is practical and can be carried anywhere[2]. Mobile payment is an application that is widely used by the public, whose development is very significant both in developing and developed countries[3]. This mobile payment feature has reached into several applications used by the Indonesian people, such as those found in the Si Toya Wening application. This application is an application made by the Surakarta City Regional Drinking Water Company (PDAM) which has a scope of work in serving the management of water availability both inside and outside the area[4]. In addition to the payment feature, there are also other features in this application such as registering new pipe connections, complaints, reporting meter numbers, and other features related to PDAM. This application is expected to facilitate access to customers so that it will increase customer satisfaction of PDAM Surakarta.

Derived from the observation findings in the suggestions and criticism feature in the Si Toya Wening application, there are several complaints about the appearance of the interface and difficulties when using the application. This is also reinforced based on the results of a pre-research survey that has been conducted to 154 application users which indicates problems with usability. Usability is a quality attribute that assesses the appearance of the interface carried out by users[5]. Indications of usability problems in this application are inconsistent application language, elements that override each other, uncomfortable navigation, unattractive appearance, and several other problems. To enhance the quality of the Si Toya Wening application and improve the user experience to be better, there is one method that can be used to overcome user problems, namely design thinking.

Design thinking has the ability to solve problems by providing solutions that focus on user needs so that the solution can provide benefits and positive experiences for users[6]. In Design thinking there are five stages which include empathize, define, ideate, prototype, and test[7], [8]. Starting from understanding the user's perceived problem, generating a solution, and checking whether the solution is right for the initial problem is what will be done to improve the usability of this application[8]. The approach used to test usability is usability testing and system usability scale, usability testing is used to see whether the resulting design is successful for

users and not based on what the designer thinks in using the design[9]. System usability scale is a method for measuring user perceptions of a product which amounts to 10 instruments that are fast and free to use[10]. The method used in this study has also been used in previous studies.

In 2021 there is research that designs village head election applications use the design thinking method. After the researcher has carried out the empathize, define, prototype, and test stages, after that testing using the system usability scale method gets a good grade, namely B or 77[11]. In 2022, this system usability scale was used to measure the usability of the 'PeduliLindungi' application. With the background of testing the usability of this application, testing was carried out on the application to 39 respondents by getting grade D or 65, but then improvements were made so that grade A or 81[12]. The same method was also used in 2023 in research on usability evaluation and redesign of mobile cinema 21. Researchers used usability testing and system usability scale to test the application, the results also showed an increase in value from the original 61.31 to 81.07 with grade scale "B", adjective ratings "EXCELLENT", and acceptability ranges "ACCEPTABLE" [13]. In the same year there was also research using the design thinking method and system usability scale with the Humaira Cakes application study case. The research was conducted due to the need for mobile transaction procurement, then by doing design thinking and testing to 5 people showed 70 points with grade C[14]. With almost the same case in research with a study case of mobile applications for men's fashion products at Celsius stores, researchers also use the same method to build these applications. After creating a solution based on user problems, researchers conducted usability testing on 10 people and tested the system usability scale. The obtained results show a score of 95 by entering into the best imaginable adjective ratings with grade scale A[15].

From the description above, this research was conducted to enhancing the usability value of the Si Toya Wening application. By using a design method that focuses on user problems, namely the design thinking method[16]. It is expected that there will be an increase in the system usability scale score from before. If there is an increase in the system usability scale score, the resulting prototype can be a reference material for improving the appearance of the si toya wening application.

2. RESEARCH METHODOLOGY

2.1. Research Stages

This research aims to redesign the interface of the Si Toya Wening application using the design thinking method. After that, to test the design that has been made, the testing stage will be carried out using the usability testing method and the system usability scale which is useful for measuring the level of usability of the design that has been made. The stages of this research are illustrated in Figure 1.

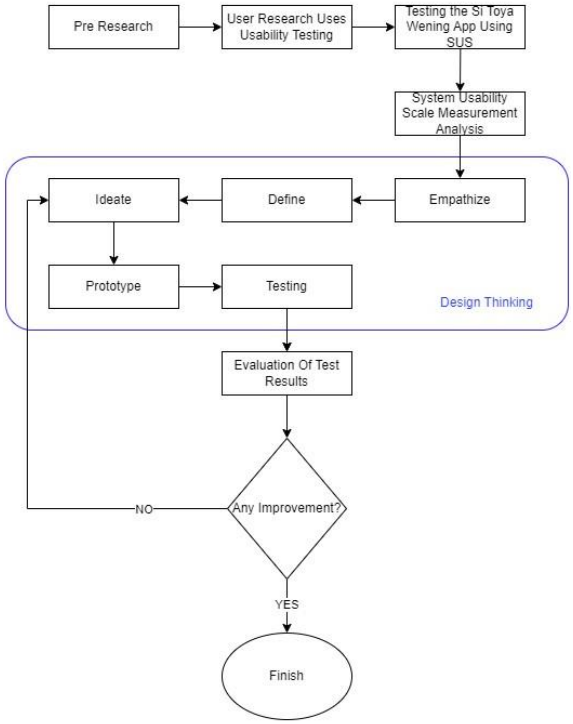

Figure 1. Flowchart of Research Stages

2.2. Pre Research

At this stage, a pre-research survey was conducted by distributing questionnaires to all users of the si toya wening application, namely 485 users. After getting the results of the pre-research survey, identification of problems experienced by users can be done at one of the design thinking stages, namely empathize.

2.3. Usability Testing

In the user identification process that focuses on the conditions that allow users to use the Si Toya Wening application will be carried out at this stage[13]. At this stage, users will be asked to try the Si Toya Wening application to follow several task scenarios that have been provided. The purpose of creating a task scenario is to see whether users can use the Si Toya Wening application easily or not, as evaluation material to improve this application. Usability testing is carried out at the same time during the pre-research survey and during the final stage of System usability scale testing. The following are some task scenarios that can be followed by users shown in table 1.

Table 1. Scenario Task

Scenario Task	Goals
User Task 1	User logs in to the application.
User Task 2	User makes payment.
User Task 3	User makes a complaint in the service section.

User Task 4	User performs the contact us feature in the miscellaneous section.
User Task 5	User access information section
User Task 6	User changes password
User Task 7	User logs out

2.4. Application Testing Using The System Usability Scale

A. Questionnaire Preparation

System Usability Scale (SUS) is a method for testing a product, with instruments that measure usability perceptions[17]. This method was created by John Brooke in 1980, with a total of 10 instruments then respondents can choose a Likert scale of 1-5 regarding how much agreement with the question instrument[10]. Because the target of this respondent is an Indonesian citizen, it must adopt SUS guidelines in Indonesian[18]. SUS questions are positive for even numbers and negative for odd numbers shown in table 2.

Table 2. System Usability Scale Questions[10]

No Item	Questions
1	I think that I would like to use this system frequently.
2	I found the system unnecessarily complex.
3	I thought the system was easy to use.
4	I think that I would need the support of a technical person to be able to use this system..
5	I found the various functions in this system were well integrated.
6	I thought there was too much inconsistency in this system.
7	I would imagine that most people would learn to use this system very quickly.
8	I found the system very cumbersome to use.
9	I felt very confident using the system.
10	I needed to learn a lot of things before I could get going with this system.

B. Questionnaire Distribution

The questionnaire distribution was addressed to Si Toya Wening users with a total population of 485 users, to calculate the sample size used for this study using the Slovin formula. Furthermore, the slovin formula used here uses a 10% margin of error [19] To get a total sample (n) based on the total population (N) can be seen in equation 1 below.

$$n = \frac{N}{1+N\,e^2} \quad (1)$$

By using the formula above, the total sample required $= \frac{485}{1+(485\times0.10\times0.10)} = \frac{485}{5.85} = 82.90 \approx 83$ people sample.

C. Process Questionnaire data

After the data is obtained, the overall processing of the system usability scale questionnaire results will be carried out, namely to ensure that the data collected is valid and reliable. For the validity test, if the value of the correlation between the overall statement instruments (r) in the study > r table, then the statement items are valid. Regarding the reliability test, if the Cronbach's alpha value exceeds 0.60, the questionnaire is considered consistent or reliable. In the validity test and reliability test using SPSS version 29 tools.

2.5. Analysis of System Usability Scale Value Measurement

During the phase, the SUS score will be calculated based on the data that has been obtained. To get the sus score, you can use the formula in equation 2 [20].

$$SUS\ SCORE = 2.5 \times \left[\sum_{n=1}^{5}(U_{2n-1} - 1) + (5 - U_{2n})\right] \quad (2)$$

Then for the assessment of the system usability scale there are 3 categories, namely, Adjective ratings, grade scale, acceptability ranges.The average of all data processed using equation 2 can be obtained based on Figure 2.

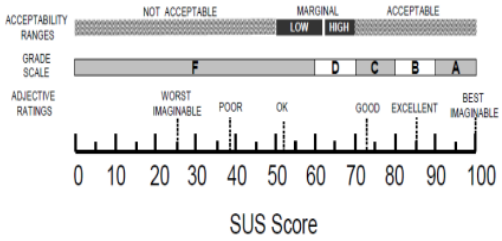

Figure 2. System Usabilty Scale Score[21]

2.6. Design Thinking

Design thinking is a thought in design that represents an approach to problems based on idea generation [22]. Design thinking consists of 5 phases as described in the book [22] which consists of.

A. Empathize

Empathize is the steps to learn and understand the user when using the product. To empathize with users can be done by observing users, then after the data is collected, tools can be made to better understand them, namely empathy maps, user personas, user stories and user journey maps.

B. Define

Define is a stage to change the problems experienced by users into determining needs. The step that can be taken to help turn problems into problem definitions is to create a 'problem statement'.

C. Ideate

Ideate is a stage to generate ideas that become solutions from the previous stage. To generate ideas from the previous stage, you can do brainstorming with the 'how might we?' method.

D. Prototype

Prototype is to create a mockup concept based on the ideas that have been created. In this stage, the idea that has been created can be turned into a prototype that demonstrates the product being made. The steps required at this stage are to create low-fidelity (wireframe) and high-fidelity prototypes.

E. Test

Test is to try the prototype that has been made to the user in order to get feedback on the ideas made.

To try the prototype, users can try this application with the usability testing method and also fill out a system usability scale questionnaire so that a comparison can be obtained.

2.7. Evaluation

In the evaluation stage, the SUS score results obtained at the beginning before the redesign will be compared with the final SUS score results. If the usability value based on Acceptability ranges, adjective ratings, and the initial grade scale is higher, it must return to the ideate stage[22]. If on the contrary, the design thinking process carried out can be said to be successful.

3. RESULT

3.1. User Research Results

After conducting research to users using pre-research and usability testing, various kinds of complaints experienced by users were obtained. Users whose average gender is male 82.5% and age dominated by more than 32 years 83.8% have quite a lot of complaints on the application. many complain about fonts, buttons, simple displays, and various other display problems. The following is some of the feedback obtained from respondents who represent complaints on the Si Toya Wening application shown in table 3.

Table 3. Statement Results According To Respondents

Respondent	Statement
R3	"Improve the payment feature"
R17	"Display is so simple that it is not attractive"
R19	"Display is too simple, ads are distracting, information board display is not attractive"
R24	"Option to view important passwords, often mistyped passwords"
R33	" Make the display more attractive and easy to understand"
R41	" Display is simple but too monotonous"
R65	"Improve Display (Color, Font, Layout)"
R100	"My suggestion maybe font is made a little big, the button is made medium."
R119	" Color display is made more distinctive, icons are more informative, the arrangement between icons and news flashes should be reorganized".
R130	"Navigation is difficult, it looks like the button to switch pages is reorganized"

From what has been conveyed by users, researchers also provide display improvement options by considering user opinions. The results obtained in the form of statements and total agreement of respondents are that the basaha is made consistent and harmonious (96.8%), improvement of overlapping components (99.4%), making the bottom navigation bar 4 icons (90.9%). alignment of icons with one theme (95.5%), making information boards better (96.1%), and a very simple display needs to be improved (94.2%)..

3.2. Data Processing

At this stage, data processing is carried out from the results of the system usability scale questionnaire that has been distributed and filled in by 83 users of the si toya wening application. The collected data is subsequently summarized, to facilitate the validity testing process using SPSS version 29. The validity test is carried out to test the valid value of all respondents' answers that have been collected. The statement items are legitimate or valid if the study's overall statement instrument's correlation coefficient (r) > the value of r in the table. Conversely, if the correlation value (r) in the research < the table r value, then the statement items are considered invalid. The r table value for 83 respondents is 0.220, to achieve a valid research instrument r count must be > 0.220 at the 5% significance level. The validity test results using the System Usability Scale (SUS) questionnaire are presented in Table 4.

Table 4. Validity Test Results

No	R Table	R Count	Description
1	0,220	0,571	Valid
2	0,220	0,373	Valid
3	0,220	0,577	Valid
4	0,220	0,631	Valid
5	0,220	0,486	Valid
6	0,220	0,530	Valid
7	0,220	0,422	Valid
8	0,220	0,575	Valid
9	0,220	0,458	Valid
10	0,220	0,438	Valid

After testing the validity of the next step, namely testing the reliability of the data using Cronbach alpha in order to produce the accuracy of the data results in all the data that has been collected. Reliability testing is carried out to find out each statement in the research instrument is interconnected. The application used to test the Cronbach alpha value of the overall measurement scale is SPSS version 29. If the Cronbach alpha > 0.60, the questionnaire is declared consistent or reliable. Meanwhile, if on the contrary, namely Cronbach alpha value < 0.60, the questionnaire is declared inconsistent. The results of the reliability test conducted using the System Usability Scale questionnaire are displayed in Table 5.

Table 5. Reability Test Results

No	Cronbach's alpha if them Deleted	Cronbach alpha (0,60)	Description
1	0,651		Reliabel
2	0,682		Reliabel
3	0,636		Reliabel
4	0,624		Reliabel
5	0,653	0,677	Reliabel
6	0,646		Reliabel
7	0,665		Reliabel
8	0,642		Reliabel
9	0,659		Reliabel
10	0,668		Reliabel

3.3. System Usability Scale Value Measurement Analysis Results First Stage

After the system usability scale questionnaire data was obtained from 83 respondents, the resulting user assessment of the Si Toya Wening application with a SUS score of 62.35. These results shown in figure 3.

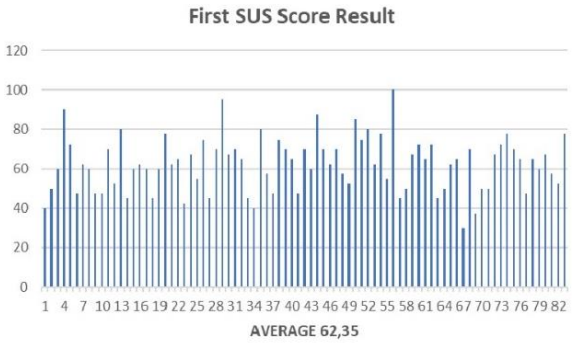

Figure 3. First SUS Score Result

3.4. Empathize

At this stage, several stages are carried out to empathize with the users of the si toya wening application in order to find out more about user problems. The following are the stages at the emphathize stage.

A. Empathy Map

At this stage, mapping the problems experienced by users based on what is said (says), what is thought (thinks), what is done (does), and what is felt (feels) in the diagram. By making this empathy map, it can make it easier to visualize the empathy of users so that the data obtained previously can become insight in the process of redesigning the Si Toya Wening application. The following is the result of the empathy map shown in figure 4.

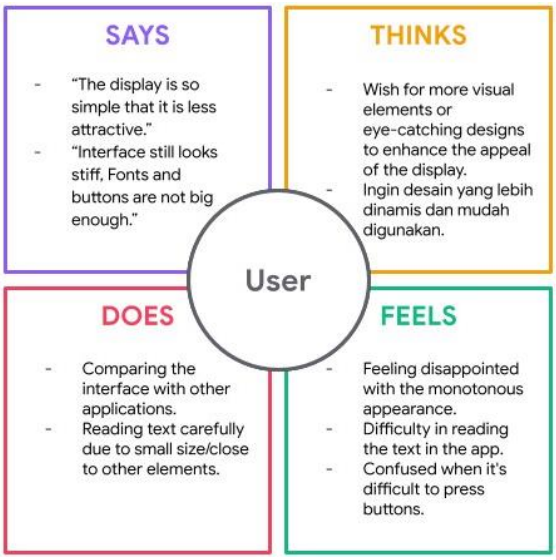

Figure 4. Empathy Map

After knowing the various kinds of problems from the empathy map, the pain point of the user can be determined. Pain points are problems that frustrate users and prevent users from getting what they need. The pain points found are that the display looks too simple, rigid, not uptodate, the font is too small, the navigation bar is not appropriate, there are overlapping elements, the icons are not aligned, the feature grouping is not appropriate, and the language is not uniform.

B. User Persona

From the previous data that has been processed into an empathy map and produces pain points from users, the next step is to explore the characteristics, goals, and needs of many users represented in the user persona. From the data taken previously, the average user of si toya wening is male with a percentage of 82.5% and age above 32 years with a percentage of 83.8%, so that user biographies can be determined. For user goals and frustrations can be taken from the results of the empathy map. The following are the results of user personas that represent users of the Si Toya wening application. The following is a user persona that has been created in figure 5.

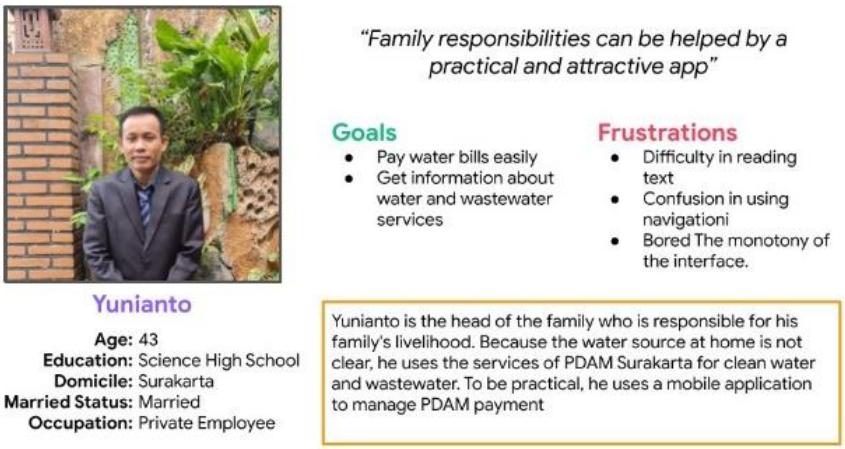

Figure 5. User Persona

DOI: https://doi.org/10.52436/1.jutif.2024.5.4.2140
p-ISSN: 2723-3863
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C. User Story

Figure 6. User Story

Based on figure 6 above, it shows the needs of users in achieving their goals, it is necessary to take a sentence from point of view (POV) of the user persona that has been created. With this sentence, it can be seen who has a problem (user), what are the problems and needs (need), and the benefits to be obtained (insight).

D. User Journey Map

In this stage, a user journey map will be created to find out the sequence of user activities when interacting with the toya wening application in order to better empathize with users, through the steps experienced by users in achieving their goals. This user journey map is the last step of empathize, starting from the user persona as a character, user story as a story plot, and this user journey map as a story framework so that it becomes one unit. The following is a user journey map based on pain points from users shown in table 6.

Table 6. User Journey Map

Activity	Login	List of water connections	Payments	Complaints	Logout
Detail Activity	A. Enter the registered email. B. Entering the password. C. Pressing the login button	A. Select a new water connection feature B. Read the terms and conditions C. Select drinking water or wastewater D. Fill out the form	A. Selecting the Bills feature B. Entering the customer id C. Pressing the search button D. Select a payment method and pay.	A. Selecting the complaint feature B. Adding a new complaint C. Selecting user/non D. Fill out the form E. Submit	A. Press the button at the bottom corner of the navigation bar. B. Pressing OK
Feeling / Emotions User	Finding it difficult because there is no view password button.	Bored because the display is monotonous and less interesting	Difficulty due to unattractive display and buttons.	Confused because there is no empty data message.	Confusion due to inconsistent language and inappropriate navbar features.
Improvisation Opportunities	Provide a view password button for users who are unsure of their password.	Improve the appearance to make it look attractive and effective	Create a details popup and make the buttons consistent.	Gives an empty data message.	Fixed the bottom navbar and set one language for consistency.

3.5. Define

Based on the results of the previous stage, namely empathizing with users, after that this stage will define the main problem to be solved. From the results of pain points, user personas, user stories, and user journey maps that have been made, then formed in the form of problem statements.

A. Problem Statement

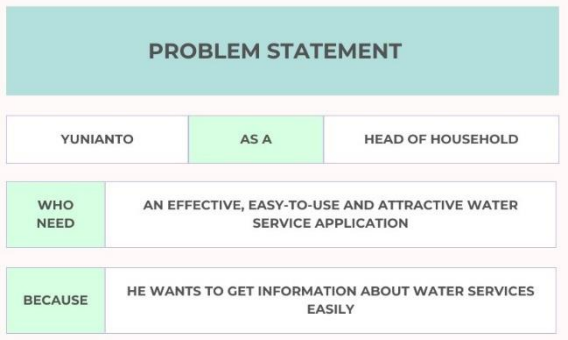


Figure 7. Problem Statement

The problem statement obtained from yunianto's user persona, user story, and user journey map will be formed into one sentence which aims to set clear goals, understand the obstacles, and make a standard for whether a toya wening application is successful or not. This problem statement will contain the names and characteristics of user personas, user needs based on user stories, and user reasons based on empathy maps and user journey maps. The following are the results obtained. The following problem statement is made in figure 7.

3.6. Ideate

This stage aims to generate ideas that will be developed based on the previous stages. The ideas that are created are then processed into design designs at a later stage. The following is the method used in ideate.

A. How Might Be

Based on the previous stage which resulted in defining the main problem of the user (problem statement), at this stage it will be developed from the main problem into ideas through brainstorming how might be. The outcomes of the brainstorming session, utilizing the "how might we" approach, are presented in Table 7.

Table 7. Brainstorming How Might Be

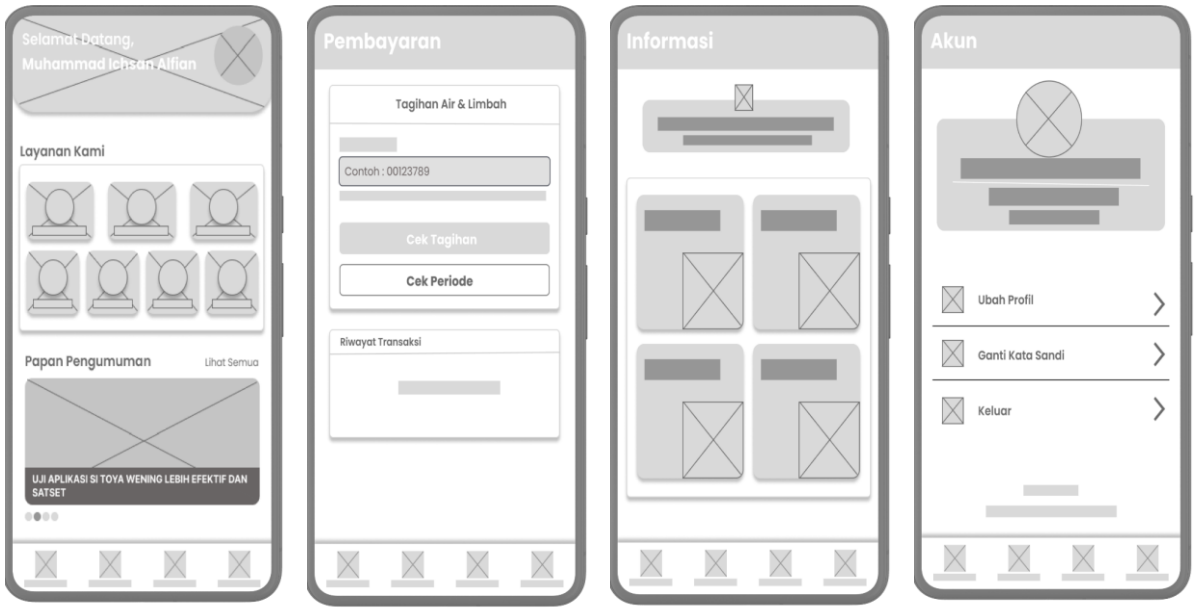
Problem Statement	Result How Might Be
Yunianto is a family head who needs a water service application that is effective, easy to use, and attractive. because he wants to get information about water services easily.	Change the Bottom NavBar according to its function Harmonize the language used Creating a more up-to-date and attractive appearance Grouping features according to function. Change the banner to be more functional. Aligning icons on features. Adding help messages. Fixing elements that collide.

3.7. Prototype

This stage aims to obtain information on user responses or feedback on the system through user interaction with the prototype that has been developed[23]. After doing the previous stage, namely brainstorming how might be, an idea was obtained that could be poured into the design of the Si Toya Wening application. To demonstrate the interface to users, from the ideas that have been obtained, a wireframe of this application is made which emphasizes functionality and can then be continued as a prototype that fully simulates the Si Toya Wening application that has been redesigned. The following are the stages in the prototype.

A. Low Fidelity / Wireframe Result

Wireframe is the initial framework before the application interface is designed, wireframe aims to describe the location of information before the user interface is made[23]. Because several problems were found at the previous stage, a redesign of the display was made. The most improved thing in this wirefreme is in terms of navigation between pages, grouping according to function, adjusting the composition of more attractive features, adding help information, and a more current display according to the user problems obtained. The following views of some wireframes of the application can be seen in figure 8 (a), (b), (c) and (d).



(a) (b) (c) (d)

Figure 8. (a)Wireframe Main / Home Page, (b) Wireframe Payment Page, (c) Wireframe Information Page, and (d) Wireframe Account Page

B. High Fidelity Prototype Result

After the low fidelity display is created, the functionality is clearly visible. However, the display created still does not look comprehensive. To get a comprehensive view, a high fidelity prototype view is needed. From the wireframe display, it will be made into a prototype by adding typography, color, and iconography visual design elements. Which shown in figure 9 (a), (b), (c), (d), (e), (f), (g), and (h)

In the process of making this prototype, it is made based on ideas that have been made in the ideate process which shown in table 7. It shown that figures (b), (d), (f), and (h) are the results of the interpretation of solving user problems listed in the previous step, namely the user research stage.

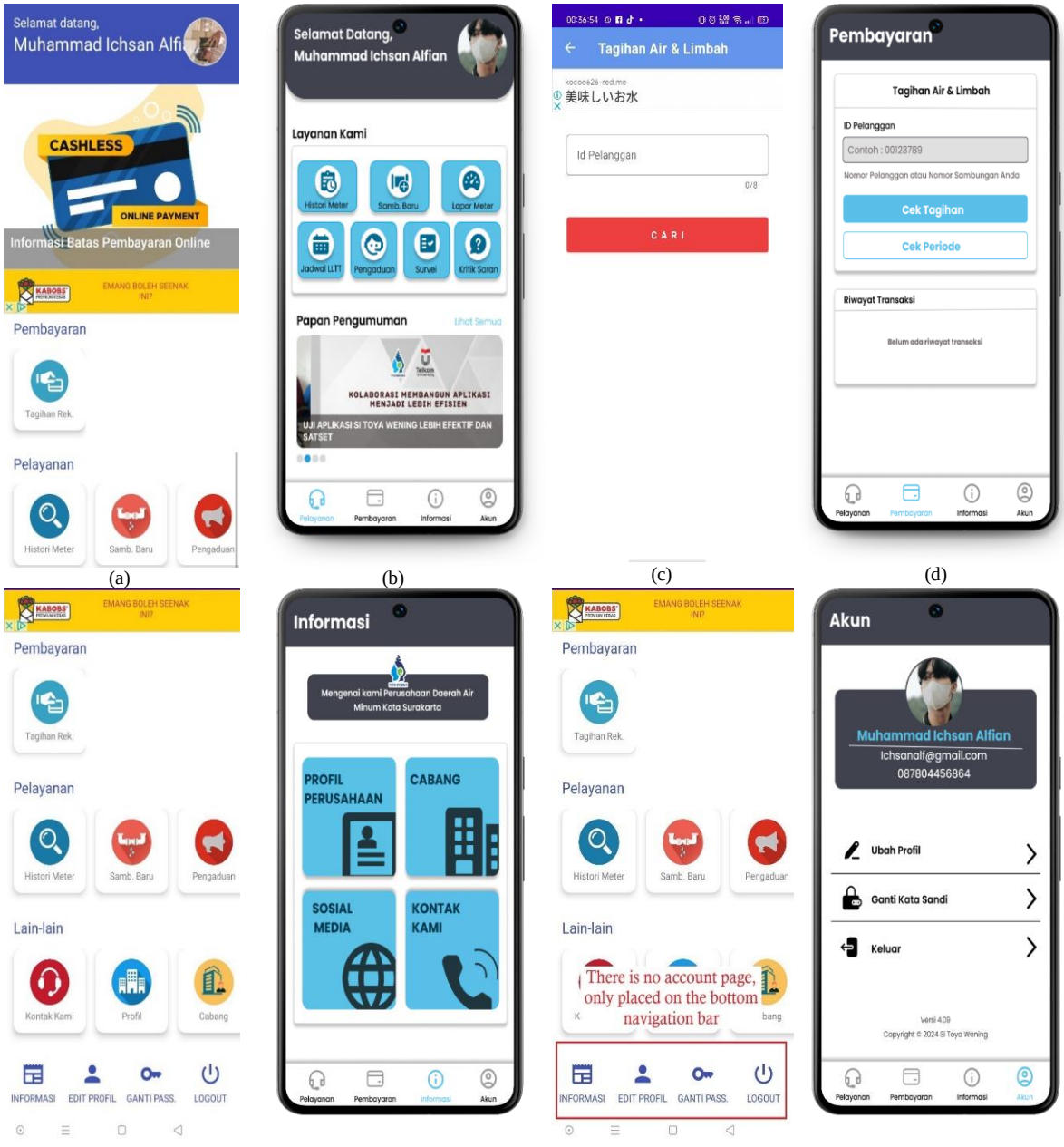


Figure 9. (a) Main Page Before, (b) Main Page After, (c) Payment Page Before, (d) Payment Page After, (e) Information Page Before, (f) Information Page After, (g) Account Page Before, and (h) Account Page After

3.8. Prototype Testing Results

This stage will analyze the results of prototype testing that has been tested on 83 respondents of the same si toya wening application as the initial test. Tests carried out using the results of prototype formation from the high fidelity prototype stage that has been made before. After testing the prototype using usability testing. Feedback from users shows that almost all users show good responses such as the appearance is getting better, and easy to understand, in terms of appearance there has been an increase, it is easier to operate, and 87.2% agree with the improvement of the appearance.Then, for the results of measuring the SUS value, the usability value is determined through calculations using the system usability scale. This usability value is based on grade scale, adjective ratings and acceptability range. To see the comparison of the measurement results at the initial stage and the final stage, it shown in figure 10.

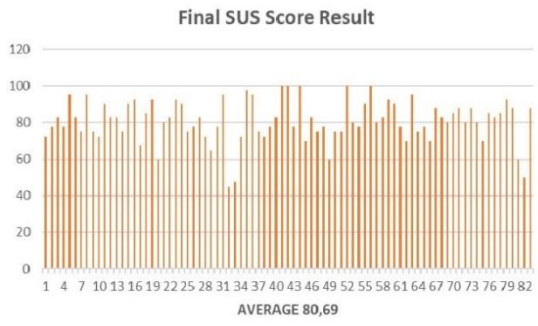


Figure 10. Final SUS Score result

The results of the assessment by the user of the si toya wening application against the object of research in this prototype test get a SUS score of 80.69. With this score classified as a grade scale category "B", adjective ratings category "EXCELLENT" and acceptability ranges category "ACCEPTABLE". With this score, it shows that the application can be accepted by users.

4. DISCUSSION

The research conducted on the SI Toya wening application is an evaluation and redesign of the application interface. Redesigning the appearance using the same method in previous research [11], [14], [15] namely design thinking. By doing 5 stages in this method, the research conducted can run according to the flow. The method used to determine how the user's understanding of this application can be known through the usability testing method used in research [11], [13], [15] because users are given certain tasks to achieve goals. In the test method that measures the value of user usability in this study using the same method in the previous research [11], [12], [13], [14], [15]. The system usability value produced in this study shown in Figure 11 which compares the results of the first system usability scale score with the final system usability scale score.

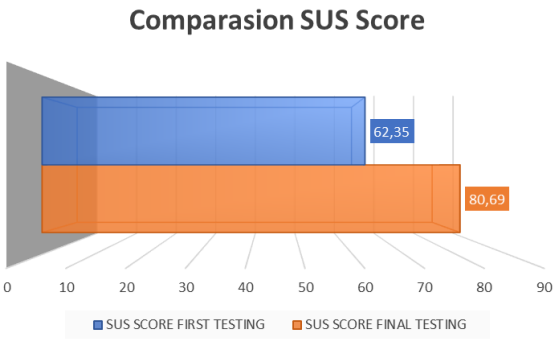


Figure 11. SUS Score Comparasion Results

Based on the results of the comparison of the first system usability scale score and the final system usability score, it can be seen that there is a very significant increase, namely from 62.35 to 80.69. when compared to previous research, the results obtained in this study are higher than the results of research [11] with SUS Score 77.00 and research [14] with SUS Score 70.00. The results obtained in research [12] and [13] are almost close to the results of this study, which are at 81. However, this result is also very much determined by the number of respondents tested, in research [11] and [15] the number of respondents is 10, research [12] total respondents 35, research [13] total respondents 43, research [14] total respondents 5, and in this study the number of respondents is 83. Of course, the more respondents tested the results will be more accurate and closer to the results of the original user population. If look at Figure 2, there are 3 category of this usability score system, namely from the grade scale, acceptability ranges, and adjective ratings. When compared with previous research, then the grade scale, research [11] and [14] fall into the "C" category. Whereas in research [12], [13] and this study show the grade scale category "B". In terms of acceptability ranges, this research and all previous researches [11], [12], [13], [14], [15] fall into the "ACCEPTABLE". In terms of adjective ratings, research [14] still gets the "GOOD" category while this research and other research [11], [12], [13] get the "EXCELLENT" category. With the comparison of this research to previous research, it adds evidence that the method used in design, namely design thinking, can solve the problems experienced by users in operating the interface of an application. This is evidenced in the tests that have been carried out getting a drastic increase in usability value. And for the usability testing method, it can still be used as a method of finding problems experienced by users. And finally, the system usability scale method can show how much the usability value of an application can be done with a different number of respondents. It should also be noted that the more respondents or samples will show a more perfect usability value.

5. CONCLUSION

After this research, it can be concluded that there are several usability problems raised by users of the Si Toya Wening application through pre-research surveys and usability testing. Then after doing the design thinking stage starting from empathizing with user problems, defining problems, making ideas from existing problems, creating prototypes, and testing the Si Toya Wening application users again, it has a significant impact. This impact can be seen based on the system usability scale score which rose from 62.35 during the first test, increasing to 80.69 in the final test. Comparison of usability scores shows an increase from category "D" to "B" on the grade scale, from "OK" to "EXCELLENT" on adjective ratings, and from "MARGINAL LOW" to "ACCEPTABLE" on Acceptability ranges. Although the sample used in this study is 83 users, it is expected to represent all users of this application which has a total of 485 users. Researchers assume that if the appearance of this application is developed again by considering a larger font size but also paying attention to aesthetics, maybe the value of the SUS score can increase again because the main problem of users here is users who are 83.8% older than 32 years. With the results obtained in this study showing a significant increase in usability, it proves that the method used in this study is effective for the continuity of the research.

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