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Usability Testing and User Interface Improvement of Mobile Banking Application: Livin' by Mandiri

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***Abstract*— Livin' by Mandiri is a mobile banking application that is integrated with Bank Mandiri banking services and its digital ecosystem. However, some users reported negative responses regarding usability aspects. This study aimed to determine the usability problems faced by users, measure the level of usability, and recommend the user interface design for usability improvement. The evaluation was carried out using the Usability Testing method which collected quantitative and qualitative data. Quantitative data was collected by measuring usability metrics data gathered while participants worked on task scenarios and filled out questionnaire. Meanwhile, qualitative data is collected through interviews with participants to gain insight from users on usability issues. The evaluation of the existed application show that the value of the learnability aspect was 68%, the efficiency was 0.013189 goals/sec, the error was 33.28% and the satisfaction aspect score was 73.5 (good). Participants said that the difficulties they faced most were features or menus that were difficult to find or unknown. Next, recommendations were construct to solve the problem by implementing usability guidelines. The user interface design recommendations were manifested in a high-fidelity prototype. The prototype was also evaluated with the usability testing method. The prototype evaluation showed an improvement of usability. The learnability aspect increased to 93%, the efficiency aspect increased to 0.026295 goals/sec, the error decreased to 2.34%, and the satisfaction aspect score was 84.4 (excellent).**

***Index Terms*—usability, usability testing, mobile banking, Livin' by Mandiri**

I. Introduction

Bank Mandiri is the largest state-owned financial services in Indonesia [1] which is currently developing digital banking services [2]. The Livin by Mandiri mobile banking application is Bank Mandiri's answer to the demands of the global trend of digitizing banking services. Bank Mandiri took advantage of the momentum of the COVID-19 pandemic in 2020, when the lockdown mechanism were imposed, to demonstrate an easy and fast digital banking service experience.

The Livin' by Mandiri application has indeed succeeded in realizing the changing vision of Bank Mandiri's digital services. However, some users conveyed negative responses through comments on the Google Play Store page of the Livin' by Mandiri application. Some comments were related to usability, including: buttons that were difficult to access and the user interfaces were hard to access for the elderly. Usability is a quality attribute that assesses how easy a user interface is used by user [3]. These usability problems will certainly impacted the users success in achieving their goals. Moreover, they will lead to negative user experience [4]. Therefore it was necessary to evaluate the usability problems and analyze recommendations for improvement as a solution to the problems.

The evaluation was carried out using the Usability Testing method. Usability Testing is conducted by observing user behavior in carrying out tasks through a specific user interface and collecting feedback from users [5]. This study aimed to determine the usability problems faced by users, measure the level of usability, and recommend the user interface design for usability improvement. The recommendations were construct to solve the problem by implementing usability guidelines. The user interface design recommendations were manifested in a high-fidelity prototype. The prototype was also evaluated with the usability testing method to evaluate whether the recommendations have successfully solved the problem and improved usability.

II. Literature Review

A. Usability on Mobile Banking

Mobile banking has become increasingly popular in recent years, with more and more people using their smartphones to manage their finances. The usability of mobile banking applications plays a crucial role in ensuring customer satisfaction and driving user adoption. Usability refers to the ease of use and effectiveness of a system in achieving its intended

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goals, in this case, providing seamless financial services through mobile banking applications. Research has shown that the perceived usability of mobile banking applications is a significant determining factor in users' adoption and satisfaction with this technology [6].

Mobile banking technology offers a convenient solution for financial transactions, but users may still encounter challenges when accessing services, leading to complaints. A research on sentiment analysis and mobile service quality of mobile banking application shows that usability and security are the most common topic reviewed by customers [7]. To address these challenges, mobile banking applications need to prioritize usability. By designing mobile banking applications with usability in mind, financial institutions can ensure a seamless user experience that encourages trust and satisfaction.

B. Material Design as a User Interface Design Guidelines

The Material Design Guidelines (MDG) are used as a guideline in designing the user interface in this study. The Material Design Guidelines is a design language developed by Google that offers practical guidance and user interface component on how to implement high-level user perception and accessibility into mobile UI designs [8]. MDG makes it possible for consumers to have a consistent experience across many platforms and devices, independent of their screen size in order to improve user engagement, user experience, and cost-effectiveness [9]. User interface designs made with reference to the MDGs are proven to have a better level of usability on both tablets and smartphones. The research that compares the effectiveness and efficiency of a web page that is being displayed on a computer screen, tablet, and smartphone shows that the Material Design Guidelines improve the effectiveness and efficiency of content delivery on a website both on tablets and smartphones [10].

The MDG informs the basis of any great user interface, from accessibility standards to essential patterns for layout and interaction. Apart from that there is a style guide, the visual aspects of a UI that give it a distinct look and feel that can be customized. Interactive building blocks components are also provided for creating a user interface. The components can be organized into categories based on their purpose: action, containment, communication, navigation, selection, and text input.

III. METHODOLOGY

The Usability Testing was carried out on Bank Mandiri's mobile banking application called Livin' by Mandiri on the Android platform version 1.1.3. The evaluation carried out by observing participants conducting a series of tasks and listen to their feedback [5], [11]. Interviews that had been conducted with representatives from Bank Mandiri explained that the features frequently used by users are fund transfers, payments (Payments), e-wallet and e-money top-ups, also the "Quick Pick" feature. Table 1 shows the list of test tasks scenario.

Table 1. Lists of Test Task Scenario

Task Code	Task Scenario
T01	Make a fund transfer of IDR 5.000 to Bank Mandiri account number **********
T02	Make a top-up of IDR 20.000 to DANA e-wallet Virtual Account Number **********
T03	Make your latest e-wallet top-up transaction as favorite
T04	Integrate your DANA e-wallet
T05	Check your outgoing and payment/top-up transactions history from October 1, 2022 to October 31, 2022

The evaluation observed 20 participants [12] and interviewed 5 of them [13]. Participants were selected using a purposive sampling technique [14] based on criteria that match the criteria for Livin' by Mandiri users, specifically Indonesian citizens aged 18-40 years. The entire data collection process was carried out remotely (online) through recorded video meetings, moderated, one session per one participant [15].

The evaluation collected qualitative and quantitative data. Qualitative data collection focuses on gathering insight and feedback from users on the problems encountered when carrying out tasks, so that specific problems faced by users can be identified [5]. Qualitative data were collected by interviewing 5 participants [13] at the end of the test. Meanwhile, quantitative data collection involved 20 participants [12] focuses on calculating metrics for benchmarking purpose to verify how good the usability of the application is [5]. Four of the five aspects of usability [3] were evaluated, i.e., learnability, efficiency, errors, and satisfaction. Memorability was not measured in this study because the study focused on problems of the new users.

Learnability related to how easy it is for users to complete tasks the first time they use a system [3]. The learnability aspect is measured by the Success Rate metric [16] which calculates the level of success of a user in completing a task in testing. Success Rate is calculated using (1) [16].

$$\text{Success Rate} = \frac{S+(PS \times 0.5)}{\text{Total Task}} \times 100\% \qquad (1)$$

S = Number of tasks successfully completed by participant without errors; PS = Number of tasks completed by participant but with problems; Total Task = Number of tasks tested on participants

Efficiency is related to how quickly users complete tasks [3]. The efficiency aspect is measured by the Time Based Efficiency metric [17], [18], the time it takes a user to complete a task in testing. Time-Based Efficiency is calculated by (2) [17], [18].

$$\text{Time Based Efficiency} = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}\frac{nij}{tij}}{NR} \qquad (2)$$

N = Number of tasks in test; R = Number of participants; nij = Result of task i done by participant j, if the user succeeds nij = 1, if he fails = 0; tij = Time spent by participant j to complete task i

Errors are related to how many errors a user makes, how severe these errors are, and how easily they can recover from errors [3]. The error aspect is measured by the Defective Rate metric [19] which counts the number of errors a user makes when completing a task in a test from the number of steps available in the task. Defective Rate is calculated by (3) [19].

$$\text{Defective Rate} = \frac{\text{Total Defects}}{\text{Total Opportunities}} \qquad (3)$$

Total Defects: Number of user errors during testing; Total Opportunities: Number of work steps in the test

Satisfaction is related to how satisfied the user is when interact with a user interface [3]. The satisfaction aspect is measured by a standardized questionnaire given after the usability testing session [18]. The System Usability Scale (SUS) questionnaire [20] was chosen to measure the satisfaction aspect. The questionnaire given to users was the adapted SUS questionnaire to Bahasa Indonesia [21]. The SUS questionnaire is recommended because it measures the overall ease of use [22], is easy to use [23], and valid for small samples [23]. The SUS questionnaire consists of 10 statements. The odd number statements (S1, S3, S5, S7 and S9) are positive statements while the even odd numbers (S2, S4, S6, S8 and S10) are negative statements. Five scales of agreement are provided. The calculation of the SUS questionnaire score uses the formula in (4). SUS score can also be interpreted in terms of adjectives such as "good," "poor," or "excellent" [24], [25].

$$\text{SUS Score} = ((S1 - 1) + (5 - S2) + (S3 - 1) + (5 - S4) + (S5 - 1) + (5 - S6) + (S7 - 1) + (5 - S8) + (S9 - 1) + (5 - S10) \times 2{,}5) \quad (4)$$

S1 to S10: Scores given by participants for statement 1 to 10. The list of statements can be seen in table 5.

After the participants completed the test and filled out the questionnaire, they were interviewed to collect quantitative data. In this interview, the researchers investigated the reasons of the actions that participants take on each scenario and why participants face difficulties during performing the tasks. We asked which parts of the system that worked well and brought pleasant for user. We also asked about their experiences with other similar banking applications. From this interview, usability issues will be determined based on the researcher's impressions, interpretations, and prior knowledge [26].

Qualitative and quantitative data were analyzed to identify usability problems. The recommendations were construct to solve the problem by implementing usability guidelines, i.e., Google Material Design Guidelines [27]. The user interface design recommendations were manifested in a high-fidelity prototype. The prototype was also evaluated with the usability testing method to evaluate whether the recommendations have successfully solved the problem and improved usability. The improvement design evaluation was tested on the same 20 participants who had been involved in the previous evaluation. The results of the improvement design evaluation were compared with the results of the initial evaluation to determine the improvement in usability.

IV. RESULTS

A. *The Evaluation of The Existing Application*

Observations were made of the participants while completing the tasks to measure the task successfully done, the time required, and the mistakes made. Table 2 shows the success rate of the participants in carrying out the task. The first task (T01) was successfully carried out by all participants (100%), while the third task (T01) had a very low success rate (8%). Table 3 shows the time-based efficiency per task. The calculation results show that the first task (T01) is done the fastest (highest efficiency) while the third task (T03) takes the longest (lowest efficiency). Table 4 shows the high error rate of users while working on tasks. It was shown that in doing the first task (T01) the participants did not make many mistakes while the most mistakes were made when working on the third task (T03).

The results of these observation indicates that there were serious problems in the third task (T03) and the fifth task (T05). Almost all of the participants failed to complete the third task (T03) that was a task to make participant's latest e-wallet top-up transaction as favorite. To complete this task, the participant should use the "Quick Pick" feature, but the participant did not realize that this feature exists that results ini failure to complete the task. The fifth task (T05) also failed to be carried out by some participants and there were many mistakes when working on the task. The reason was participants did not find the button to filter the transactions list. If the specified "Tabungan" were tapped, the participant would find the filtering button. Nonetheless, the buttons were not representatively visualized so that the participants became desperate to find them.

The results of the measurements carried out by asking participants to fill out the SUS satisfaction questionnaire are shown in Table 5. From the 10 SUS statements (code S1 to S10) it appears that the highest participant score was obtained by the statement S1, so it can be interpreted that participants feel this system is needed in everyday financial transactions. But in statement S2's the score obtained is quite low, so it can be interpreted that the system is considered complicated by the user. The lowest score was obtained in the statement S10, so that it can be interpreted that participants feel this application requires more effort to learn.

Table 2. Task Success Rate (Learnability)

Task Code	S	PS	F	Success Rate
T01	20	0	0	100%
T02	17	1	2	88%
T03	1	1	18	8%
T04	16	2	2	85%
T05	12	1	7	63%
Average				69%

S= Successfully completed task; PS= Partially success in completed task; F= Failed in completed task

Table 3. Average Time and Time-based per Task (Efficiency)

Task Code	Average time on task (sec)	Time-Based Efficiency (goals/sec)
T01	57,1	0,019714
T02	93,3	0,018273
T03	191,6	0,002803
T04	87,8	0,014512
T05	106,3	0,010644
Average	107,22	0,013189

Table 4. Defective Rate per Task (Errors)

Task Code	Def.	Opp.	Defective Rate
T01	10	140	7,1%

T02	23	140	16%
T03	103	120	85,8%
T04	16	120	13,3%
T05	61	120	50,8%
Average			33,28%

Def.= Number of user errors during testing; Opp.= Number of work steps in the test

Overall, the quantitative data calculation shows the average of task success rate was 69% (Table 2), the overall time-based was 0.013189 goals/sec (Table 3), the defective rate was 33.28% (Table 4), and the SUS score was 73.5 (Table 5). The success rate represents the learnability aspect. However, based on an analysis of 1.100 tasks [28][28], the average task success rate is 78% [18], [28]. So that, 69% is below task success rate average but it is better than 56% of all tasks [28]. The efficiency calculation shows the average time spent on task was 107,22 seconds per task and time-based was 0,013189 goals per seconds. The error calculated by the defective rate shows value of 33,28%. The satisfaction score calculated from the SUS score was 73,5 can be describes as "Acceptable" and "Good" [25].

Table 5. SUS Score per Statement (Satisfaction)

Code	SUS Statement Description	Score	Acceptable
S1	I think that I would like to use this system frequently	98,75	Acceptable
S2	I found the system unnecessarily complex.	68,75	Marginal
S3	I thought the system was easy to use.	80	Acceptable
S4	I think that I would need the support of a technical person to be able to use this system.	72,5	Acceptable
S5	I found the various functions in this system were well integrated.	92,5	Acceptable
S6	I thought there was too much inconsistency in this system.	77,5	Acceptable
S7	I would imagine that most people would learn to use this system very quickly.	73,75	Acceptable
S8	I found the system very cumbersome to use.	83,75	Acceptable
S9	I felt very confident using the system.	71,25	Acceptable
S10	I needed to learn a lot of things before I could get going with this system.	47,5	Not Acceptable
	Overall Score	73,5	Acceptable, Good

Table 6. Number and Categories of Reported Usability Problems

Problem Categories	Num. of Problems Reported
Bad design that leads to difficulties or errors	4
Unavailability of information	4
Unaware of the existing of the feature or information	3
Incomprehensible information	3
Hidden feature or information	2
Lack of options	2
Compulsion to perform undesirable actions	2
TOTAL	20

Meanwhile, the qualitative data obtained from the user interview reported 20 usability problems. Table 6 shows the categories of problems reported by participants. It was reported that there were 4 problems related to the bad design that leads to difficulties or errors; 4 problems related to the unavailability of information; 3 problems related to the unaware of the existing of the feature or information; 3 problems related to the incomprehensible information; 2 problems related to the hidden feature or information; 2 problems related to the lack of options; and 2 problems related to the compulsion to perform undesirable actions.

B. The User Interface Improvement

The first improvement was focused on the problem on task T03 that cause the most failures and errors. The problem with task T03 is that the participants did not realize that the "Quick Pick" feature exists. The improvement made are shown in Fig. 2 in section marked with "M09". A button with an arrow icon was added so that the user realizes the element is clickable and leads to the "Quick Pick" page. In addition, another problem that arises when the user has entered the "Quick Pick" menu is that the menu display does not attract attention, so it was ignored. Fig. 3 shows the improvement, namely the position of the added button was moved and the layout were arranged to the top side of the menu so that users can easily access the button without having to scroll through the existing transaction list.

The next improvement was focused on the problem on task T05 that failed to be carried out because participants did not find the button to filter the transactions list. Improvements were made by changing the filter icon type to a familiar form as shown in Fig. 4. In addition, the problem that was complained about in task T05 was the design of the date picker for filtering transaction data which made participants make many input errors. Design improvement in Fig. 5 was done by changing the date picker navigation to be sequential followed by changing the narration on the button so that you can select the start and end date periods directly in sequence without closing the date picker element. Then an icon is given to the initial period and the final period according to the text field elements so that the information addressed to the user is clearer.

Another problem is on the bottom navigation. Several problems related to the user's ignorance of the menu can be solved by determining the right bottom navigation menu. Bottom navigation can be used to move pages with equivalent levels [27]. Bottom navigation improvements include: changing the menu that enters the bottom navigation, giving a representative icon, adding color to increase the clarity of the highlight menu. Fig.6 shows that the selected menus in the bottom navigation are: "Beranda" (home), "Promo" (promotion), "Notifikasi" (notification), "Transaksi" (transactions), and "Pengaturan" (setting).

The transaction page is used as a menu in the bottom navigation because participants reported that the menu was hidden. Therefore, the transaction page was designed as a distinctive menu as shown in Fig. 7. In addition, the problem on the transaction page related to the filter icon that is not familiar to users has also been fixed.

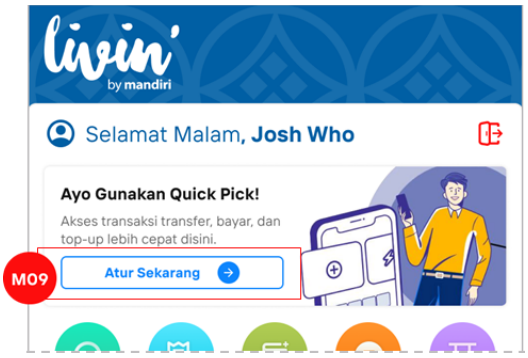

Fig. 1. Design improvements of "Quick Pick" button

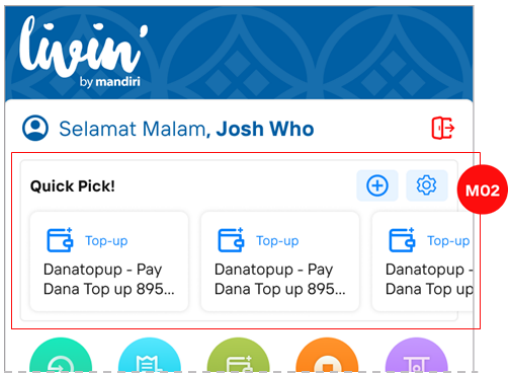

Fig. 2. Design improvements of "Quick Pick" menu

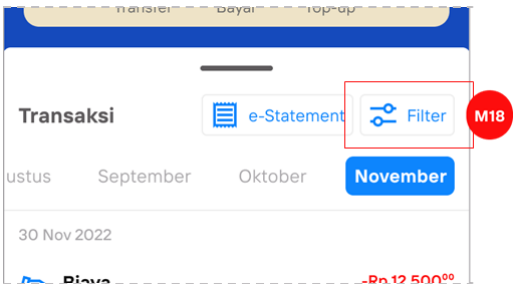

Fig. 4. Design improvements of the filter button (marked with "M18")

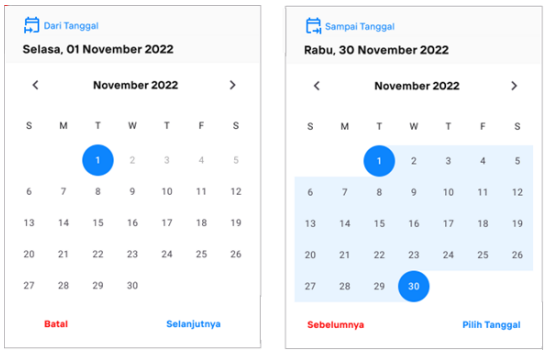

Fig. 5. Design improvements of the date picker

Other design improvements also made to other pages and in other parts of the application. On the login page, the improvements are placing the login button in a more easily accessible position (M02), as well as adding a QR code payment button to the quick-access menu on the login page (M19) as seen in Fig. 8. On the "Promo" page, as seen in Fig. 9, the layout of the Livin' Points element was set to the top position of the page (M17). The background color of the the Livin' Points was also designed so that it stands out more. On the "Notifikasi" page, as seen in Fig. 10, layout adjustments are made so that the design is more efficient. New elements are also added, with a card component that contains schedule information for days and hours of system maintenance with colors and shapes that invite the user's attention. On the "Pengaturan" page, as seen in Fig. 11, the position of the logout menu was moved to the very top of the settings page so that users who want to exit the application can quickly access the menu. Explanatory texts were also added on the second line of each settings menu.

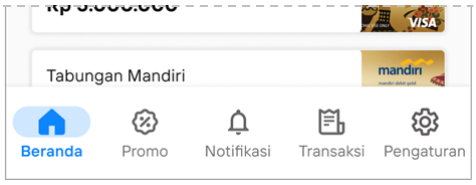

Fig. 6. Design improvements of the bottom navigation

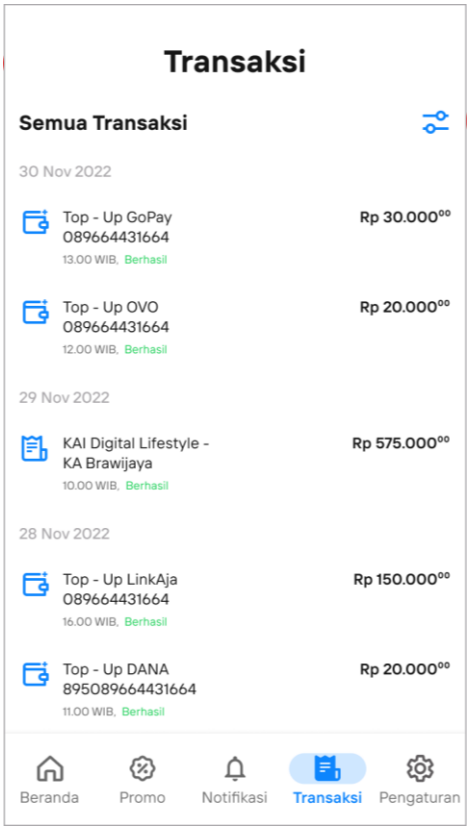

Fig. 7. Design improvements of the list of transactions page

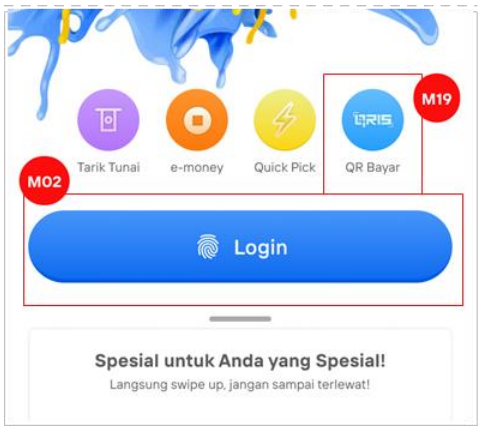

Fig. 8. Design improvements of the Login page

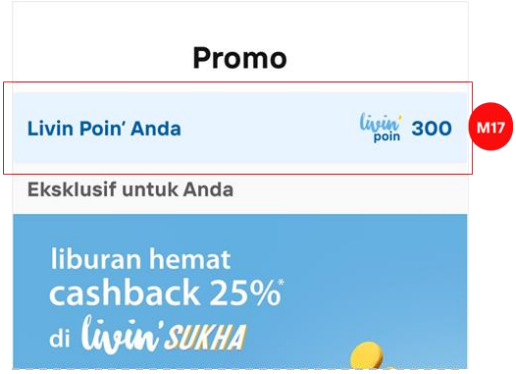

Fig. 9. Design improvements of the "Promo" page

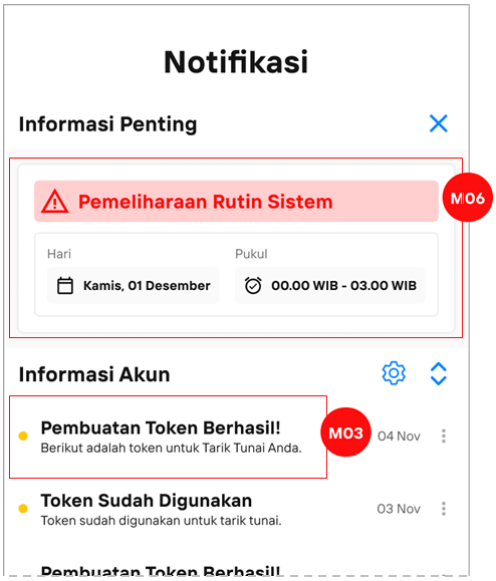

Fig. 10. Design improvements of the "Notifikasi" page

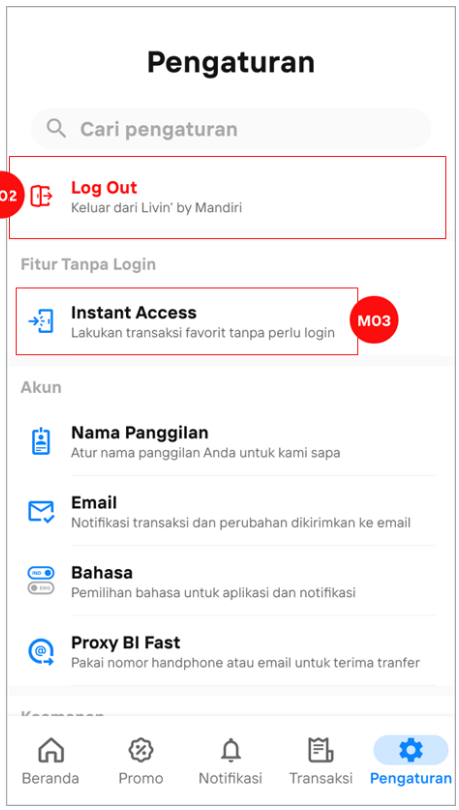

Fig. 11. Design improvements of the "Pengaturan" page

C. The Evaluation of The Improved Design

At this stage, the user interface design improvement was evaluated using the same Usability Testing method, involving the same 20 respondents that were asked to carry out the same 5 tasks. The purpose of the design improment evaluaton is to validate whether the previously found problems have been successfully resolved.

Based on the test results, the design improvements made to the problems in task T03, T05, and other tasks were successfully completed. Table 11 shows an increase in task success (learnability), a decrease in the time required to complete a task (efficiency), a decrease in the number of errors (errors), and an increase in user satisfaction (satisfaction).

Table 7. Task Completion Rate (Learnability) Before and After Improment

Task Code	Success Rate		Num. of Success (After)		
	Before	After	S	PS	F
T01	100%	100%	20	0	0
T02	88%	88%	15	5	0
T03	8%	98%	19	1	0
T04	85%	93%	17	3	0
T05	63%	85%	14	6	0
Average	69%	93%	-	-	-

S= Successfully completed task; PS= Partially success in completed task; F= Failed in completed task

Table 8. Average Time and Time-based per Task (Efficiency) Before and After Improment

Task Code	Average time on task (sec)		Time-Based Efficiency (goals/sec)	
	Before	After	Before	After
T01	57,1	44,4	0,019714	0,023391
T02	93,3	44,25	0,018273	0,024168
T03	191,6	36,2	0,002803	0,029062
T04	87,8	36,75	0,014512	0,029922
T05	106,3	43,8	0,010644	0,024933

Average	107,22	41,1	0,013189	0,026295

Table 9. Defective Rate per Task (Errors) Before and After Improment

Task Code	Defective Rate		Num. of Def. & Opp (After)	
	Before	After	Deff.	Opp.
T01	7,1%	0%	0	140
T02	16%	3.6%	5	140
T03	85,8%	0.8%	1	120
T04	13,3%	2.5%	3	120
T05	50,8%	5%	6	120
Average	33,28%	2,34%	-	-

Def.= Number of user errors during testing; Opp.= Number of work steps in the test

Table 10. SUS Score per Statement (Satisfaction) Before and After Improment

Code	Before		After	
	Score	Acceptable	Score	Acceptable
S1	98,75	Acceptable	96,25	Acceptable
S2	68,75	Marginal	83,75	Acceptable
S3	80	Acceptable	92,5	Acceptable
S4	72,5	Acceptable	92,5	Acceptable
S5	92,5	Acceptable	96,25	Acceptable
S6	77,5	Acceptable	87,5	Acceptable
S7	73,75	Acceptable	90	Acceptable
S8	83,75	Acceptable	92,5	Acceptable
S9	71,25	Acceptable	78,75	Acceptable
S10	47,5	Not Acceptable	65	Marginal
Overall	73,5	Acceptable, Good	84,4	Acceptable, Excellent

Table 11. Alteration of Usability Aspects Before and After Improment

Aspect/ Metrics	Before	After	Alteration
Learnability/ Task Completion	68%	93%	↑ 25%
Efficiency/ Time-based	0,013189 *goals/sec*	0.026295 *goals/sec*	↑ 0,013106 *goals/sec*
Error	33,28%	2,34%	↓ 30,94%
Satisfaction	73,5	84,4	↑ 10,9

Table 7 shows a significant increase in the success of completing tasks T03 as well as T05. There are still users who have partially succeeded in working on the task, but none have failed. Table 8 also shows that participants are faster in completing tasks, although participants may be faster because they are already familiar with the design through the first test. Participants still make mistakes, as shown in Table 9, but based on our observations, these problems are more common because participants accidentally press other parts (slips) [29]. Table 10 shows that user satisfaction has also increased, but statement S10 is still included in the "Marginal" category, which means that participants still feel the need for effort to learn how to use the Livin' by Mandiri application.

V. CONCLUSIONS AND RECOMMENDATIONS

The final chapter presents the achievement of the research as mentioned in the first chapter, which is the improved usability and the new user interface of Livin' by Mandiri Mobile Banking. Furthermore, the recommendations are proposed for future research and the product owners.

A. Conclusion

The initial evaluation of Livin' by Mandiri concluded that the existing application is needed to improve its usability and user experience based on the findings in this study. Based on the initial evaluation, it revealed quantitative metrics for 4 different aspects. The learnability aspect scored 68%, the efficiency achieved at 0.013189 goals/sec, the error rate reached 33.28%, and the satisfaction aspect scored 73.5 (good). In addition, for qualitative research providing a valuable 20 usability problems from the participants through user interview.

As the users faced problems with the existing application, the interaction has not provided a smooth and seamless experience, limiting their overall satisfaction. Hence, the application received backlashed negative feedback in Google Play Store review.

Using the result of the initial evaluation and reported usability problems, producing the redesigned user interface by following the guidelines of design theories as a recommendation. The redesigned user interface is presented in a Wireframe and High-Fidelity Prototype and providing users with a new set of elements and screens.

A final evaluation was conducted with the same 20 respondents to validate that the prototype meets user expectations using usability testing. The learnability aspect scored 93%, the efficiency achieved at 0.026295 goals/sec, the error rate reached 2.34%, and the satisfaction aspect scored 84.4 (excellent). Judging from the final evaluation, the redesigned user interface successfully solved usability problems and improved the value of usability.

B. Recommendation

There are some recommendations that were provided in this research. Firstly, this research involves the customer as respondent to provide insight and feedback from existing applications however it may not be fully detected as regular customers are not expert evaluators. Suggested to use alternative methods such as Heuristic Evaluation that involve expert evaluators to achieve deeper insight and usability problems that need improvement.

Furthermore, Despite every usability aspect being evaluated at the task-level, this research uses a System Usability Scale (SUS) questionnaire to evaluate overall satisfaction of usability satisfaction. To evaluate task-level satisfaction it is recommended to use Single Ease Questionnaire (SEQ) to obtain more valuable insight into the usability satisfaction aspect.

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