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Developing Prototype Model Based on Analysis of The People At The Center of Mobile App Development (PACMAD) on The Panel Harga Pangan Application

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Abstract

The increasing demand on mobile applications to monitor and analyze market trends in the food industry necessitates a focus on usability to ensure that these tools are functional and user-friendly. The Panel Harga Pangan app, which is widely utilized by traders, consumers, and policymakers, provides essential information on food prices across many marketplaces. However, as its user base grows, correcting usability concerns becomes increasingly important to its sustained effectiveness and customer happiness. This article looks into the implementation of the People at The Center of Mobile Application Development (PACMAD) usability concept on the panel harga pangan app and finally proposed the prototype to similar application. The PACMAD model, designed specifically for mobile applications, evaluates usability based on seven key criteria: effectiveness, efficiency, satisfaction, learnability, memorability, mistakes, and cognitive load. The application's effectiveness is approximately (62.5%), including efficiency (73.27%), satisfaction (64%), learnability (65.78%), memorability (70.93%), errors (68.59%), and cognitive load (72.72%). The study's findings show that the application has an average score of 68%, indicating that the program is neither particularly successful or satisfying. Issues such as less efficiency and higher error frequency diminish the overall user experience. The research includes specific recommendations for improving the app's usability, such as redesigning the user interface and optimizing onboarding processes. These findings aim to improve the user experience, ensuring that the panel harga pangan remains a reliable and user-friendly tool for its varied audience. The findings have significant consequences for applying the PACMAD model to other mobile agriculture applications.

Keywords: PACMAD model; mobile evaluation; usability testing; agriculture application

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1. Introduction

Mobile applications are becoming essential tools for a variety of industries, including the public sector, because they enable information sharing and transfer. This is the product of the digital world's rapid evolution. The widespread usage of the internet, as well as the rapid rise of information technology, has fundamentally altered the way data is conveyed, creating new opportunities for successful service delivery and communication (Hussain & Fitria, 2018; Krisnayana et al., 2024). Governments all around the world are using this technological breakthrough to implement e-government programs, which enable the rapid distribution of information via various digital channels (Ahmad et al., 2021). The quality of public services has substantially increased as a result of the move from archaic, labor-intensive methods to modern, technology-driven approaches, particularly in areas such as agricultural food security, which are critical to the country's growth. Another example is Panel Harga Pangan, which provides real-time commodity price data to help traders, consumers, politicians, and researchers make informed decisions. Agriculture is an important component of economic stability, so apps that serve as centralized hubs for real-time agricultural price data are increasingly in demand. These apps can help stakeholders make better decisions and improve economic efficiency.

Furthermore, a lack of current knowledge on agricultural food prices creates swings in agricultural production prices, affecting agricultural production price stability and resulting in dramatically divergent pricing for basic commodities

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across Indonesia. Unfortunately, the Indonesian government program known as Panel Harga Pangan still has severe UI/UX design faults, function, as well as numerous bugs that contain contradictory information, confounding users and eventually forcing them to abandon the application (Faudzi et al., 2022)(Alfatih & Mustafidah, 2022). Researchers have identified various concerns raised by users, and their unhappiness will have an impact on the application's accessibility (Damayanti et al., 2020). Usability testing relies heavily on user happiness. Usability testing measures, tests, and evaluates a system in terms of the user's ease of use of the system interface to fulfil its goals, which could lead to user satisfaction values when using it (Fitria et al., 2024). To be useable, an application must successfully provide users with the opportunity to complete the actions carried out to achieve their aims or objectives in the application as well as possible (Alshammari et al., 2015; Nielsen, 2012). Usability testing is inextricably linked to the scientific subject of Human-Computer Interaction (HCI), in which system users (people) interact with the system (ISO, 2008). Since the beginning of the 1970s, HCI research has been developing. In order to make it simple and straightforward for people to interact with the system, this science emphasizes the significance of design, user interface, and visual appearance (Cheok et al., 2004; Dillon, 2001; Wich & Kramer, 2015).

In order assess and enhance the Food Price Panel application's usability, this article focuses on applying the PACMAD model. The purpose of this evaluation is to determine the application's usability strengths and limitations in order deliver useful information that will direct future development efforts. The Food Price Panel can better serve its varied audience and maintain its status as a trustworthy and effective instrument for tracking and assessing food costs by improving the user experience. The study's conclusions also have deeper implications for the PACMAD model's implementation in other mobile agriculture apps, providing a mechanism to enhance usability on comparable digital platforms.

This study's main goal is to obtain end-user feedback on the panel harga pangan application in order to assess its usability. Direct user input, providing insights into users' impressions while using the application, can be used to evaluate usability. The PACMAD model, which includes seven essential components—learnability, efficiency, memorability, errors, satisfaction, efficiency, and cognitive load—is measured during user testing of the application. Through a comprehensive analysis of these indicators, the strengths and limitations of the Panel Harga Pangan application may be identified, allowing for focused enhancements aimed at augmenting user happiness.

According to (Krisnayana et al., 2024), usability testing on Jinom Customer using the PACMAD model has been performed in previously, and findings indicate high usability in terms of effectiveness and efficiency in cognitive load and user satisfaction. Furthermore, an evaluation of an e-walled application was conducted using the PACMAD model, which revealed that user satisfaction was the foremost usability factor (Agustiono et al., 2023). Lastly, an evaluation of the Learning Management System Taspen was accomplished using the PACMAD model, which revealed that the application's user interface needed to be improved in order to increase user satisfaction and the application's efficiency (Jumroni et al., 2023).

2. Research Methodology

In general, this research study applied quantitative methodology at the data collection stage. This research is an experimental research that carries out usability testing. Task scenarios, observations and interviews were conducted during this test. Data were analysed to determine the ease of use of the panel harga pangan application. The research stages in the implementation of usability testing on the food price panel application using the usability testing method with the PACMAD metric measurement are described on Figure 1.

This research began with a pre-field survey of markets in Lhokseumawe and North Aceh before the first phase was carried out in March 2024. The research objects were economic actors in the two regions. In the first stage, identification of problems that arise based on surveys conducted previously. Furthermore, the implementation of testing with the usability testing method by combining ISO metrics and Nielsen metrics called the PACMAD model. At this stage there are 7 metrics measured (learnability, efficiency, memorability, error rate, efficiency, satisfaction and cognitive load). Furthermore, the test results are analysed to obtain the test results of the food price panel mobile application. Recommendations and solutions are presented to provide recommendations for the application as well as conclusions from this research.

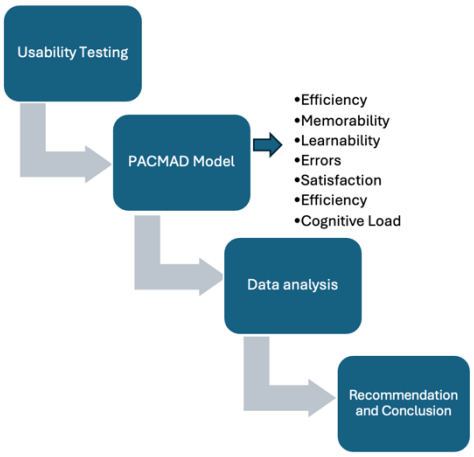

Fig. 1. Research Design Diagram

3. Result and Analysis

3.1 Test case design

In order to test the application, a test scenario is created before test execution. After identifying every feature, a data matrix was constructed.

Table 1. The Test Scenario

Scenario	Task Description
Task 1	Choose your location: Province: Aceh Aceh District/City: Banda Aceh
Task 2	Check the price of red chili pepper in Banda Aceh Task 3
Task 3	View monthly history of tuna price in Banda Aceh
Task 4	View agriculture production commodity prices in Banda Aceh
Task 5	Find the national producer-level price of shallots.
Task 6	View the table showing onion prices across Indonesia
Task 7	Submit a food price enquiry via “Bantuan Aplikasi” submenu

Users are asked to accomplish a series of tasks using the application of panel harga pangan. These tasks are designed to cover various aspects of the application’s functionality, such as searching for specific commodities prices, comparing prices across different markets, and accessing historical price data. The effectiveness, efficiency, satisfaction, error rate and cognitive load of each task are measured utilizing several concepts and observation activities.

3.2 Effectiveness Metrics

The effectiveness metric was evaluated by observing user behaviour during the test execution. The criteria observed for each task in the test scenario included, ‘the user easily completed the task on the first try when viewing the interface,’ ‘the user was able to complete the task quickly,’ and ‘the user easily corrected errors in menu selection,’ and ‘the user

made very minimal errors'. Each successfully completed task will be scored 'yes' for 100% credit, 'partially' for 50% credit, and 'no' for 0% credit for failed tasks.

According to the observations, users had difficulties executing tasks 2, 3, 4, 6, 7, and 8, with most users only completing these tasks partially (category 'Partial'). These tasks involve looking for specific information and conducting more complex actions on the interface. In tasks 1, 5, 9, and 10, approximately 20% to 40% of users completed the tasks perfectly (the 'Yes' category), whereas the remainder only completed some of the tasks. This demonstrates that, while certain tasks were completed successfully, most other tasks presented difficulty. The results revealed that there were 320 trials based on 32 task criteria, each with 10 trials. A total of 180 trials were successful, with 40 partially successful. 100 unsuccessful tasks will be abandoned because 100 multiplied by 0% equals zero. In order to get the aggregate effectiveness for this set of tasks, the following equation is used:

$$\begin{aligned} \text{Effectiveness (\%)} &= \text{Yes} + (\text{Partial} \times 0.5)) / \text{Total} \times 100\% \\ &= (180 + (40 \times 0.5)) / 320 \times 100\% \\ &= \mathbf{62.5\%} \end{aligned} \quad (1)$$

According to the equation (1), the effectiveness metric rating that has been carried out usability testing with 10 users shows a success rate of around 62.5%. Using the same formula, the Effectiveness assessment by each user can be presented in Figure 2.

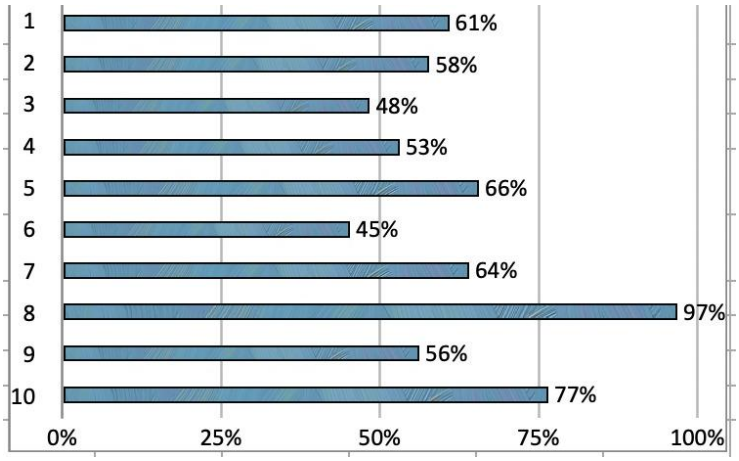

Fig. 2. Effectiveness success rate each user

3.3 Learnability Metrics

Measuring learnability metrics is also evaluated by using success rate breaking down the test case created. Based on the observation, users had difficulty in performing task 3 where 60% of users could not perform the task properly. The task asked users to find the price of a particular product. Based on the data analysis, the learnability of each user can be described as the success rate lists 32 task criteria, each requiring 10 attempts, totalling 320 attempts. There were 63 partially successful attempts and 179 fully successful attempts. A total of 78 tasks were not completed, these tasks will be ignored as 78 x 0% = 0. Therefore, we used the following equation to determine the overall learnability rating for this task set.

$$\begin{aligned} \text{Learnability (\%)} &= \text{Yes} + (\text{Partial} \times 0.5)) / \text{Total} \times 100\% \\ &= (179 + (63 \times 0.5)) / 320 \times 100\% \\ &= \mathbf{65.78\%} \end{aligned} \quad (2)$$

From the equation (2), the learnability metric assessment that has been carried out through testing with 10 users shows a learnability success rate of around 65.78%. Applying the same formula, the Effectiveness assessment by each user can be presented in Figure 3.

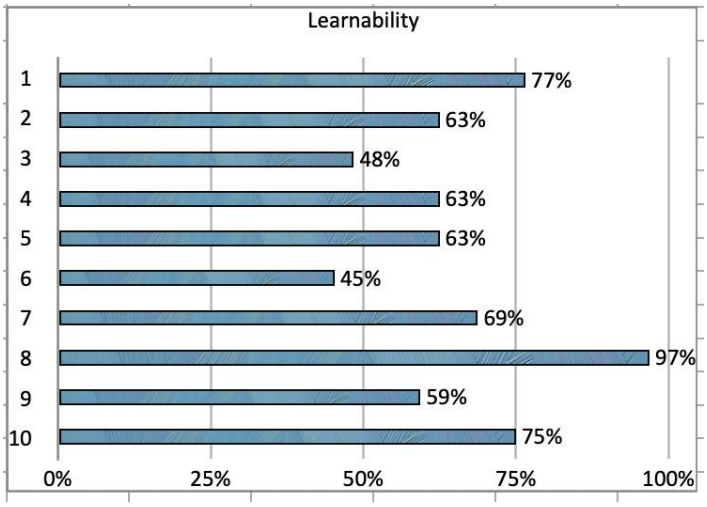

Fig. 3. Learnability success rate each user

3.4 Efficiency Metrics

Efficiency evaluates the efficient the user is in accomplishing a specific task. It is estimated using the percentage of tasks completed successfully, whether entirely, partially, or not at all. Goal efficiency (goals/sec) indicates how quickly the user can complete a task in seconds. It indicates how quickly the user may complete the task within the time period specified. The time needed to perform a work can be estimated by subtracting the start time from the end time, as illustrated in the equation:

Task Time = End Time – Start Time (3)

In this research, efficiency is evaluated based on Overall Relative Efficiency as shown in the following equation:

$$Overall\ Relative\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N} n_{ij}t_{ij}}{\sum_{j=1}^{R}\sum_{i=1}^{N} t_{ij}} \times 100\% \quad (4)$$

Efficiency assesses how efficient the user is in accomplishing a specific task. The results displays the efficiency measurement findings for 10 people who were tested. Each user was assigned a task, with completion outcomes categorized as 'Yes' (completely finished) or 'No' (not completed). In addition, the time (in seconds) taken by each user to accomplish the tasks was recorded, and the efficiency was estimated in terms of objectives per second.To calculate the overall relative efficiency of task 1, the following formula was employed. The Total Relative Efficiency of each task can be determined as follows: Efficiency (%) = 70.06+74.26+19.69+74.30+86.91+84.50+91.92+84.57 ≈ 73.27%. Based on the findings of this computation, usability testing with ten users reveals that the panel harga pangan application has an efficiency level of around 73.27%. Using the same formula, Figure 4 depicts the overall relative efficiency for each activity.

3.5 Memorability Metrics

Measuring memorability is done by observing the user while the test is being run. Each task in the test scenario is subject to the following task criteria: ‘The user selects the right menu on the first try,’ and ’The user can complete the task on the next try.’ For each criterion met, failed tasks will be marked with ‘no’ for a value of zero, ‘partially’ for a value of 50%, and ‘yes’ for a value of 100%. Based on observation analisys, the task lists 16 task criteria, each requiring 10 attempts, totaling 320 attempts. Five out of 111 attempts were only partially successful. 44 tasks failed overall, and

since 44 x 0% = 0, they will be ignored. As a result, we used the following equation to determine the overall learning ease rating for the task set:

$$\begin{aligned} \text{Memorability (\%)} &= \text{Yes} + (\text{Partial} \times 0.5)) / \text{Total} \times 100\% \\ &= (111 + (5 \times 0.5)) / 160 \times 100\% \\ &= \mathbf{70.93\%} \end{aligned} \quad (5)$$

From the equation (5), the ranking of memorability metrics that have been carried out usability testing with 10 users shows a success rate of around 70.93%. Applying the same formula, the success rate of memorability for each task can be presented in Figure 5.

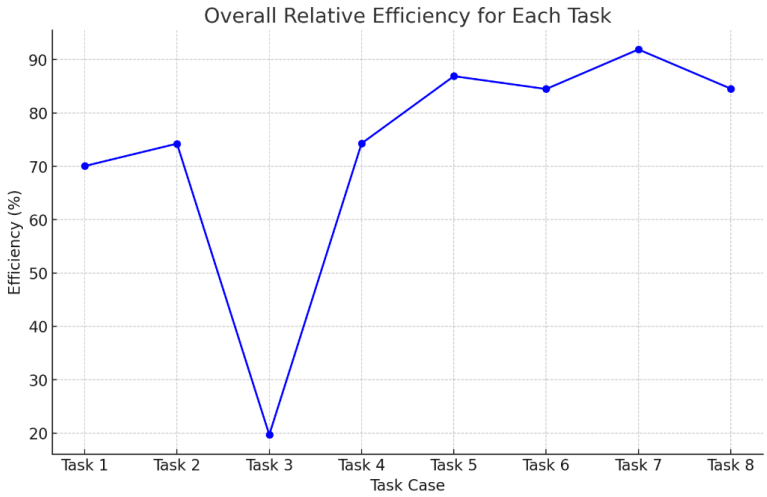

Fig. 4. Overall relative efficiency each task

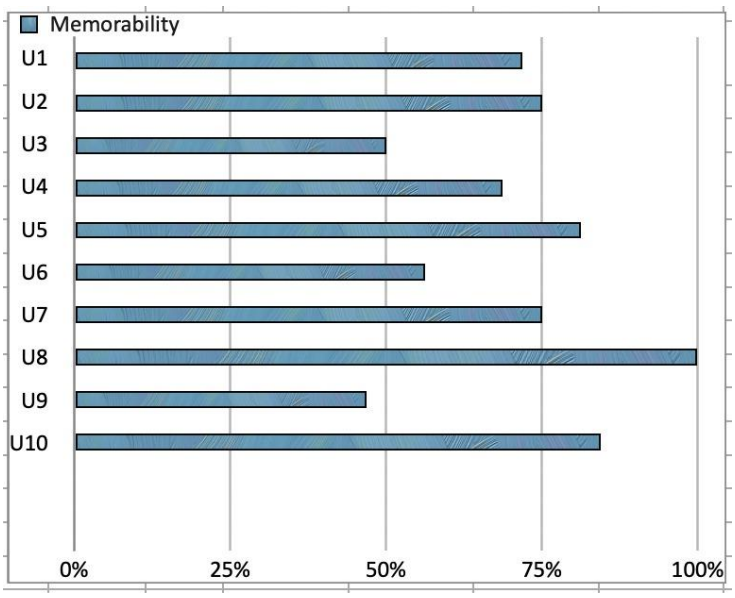

Fig. 5. Success rate of each task

3.6 Errors Metrics

Throughout the test, users were observed to identify error metrics. Task requirements, which include elements such as 'User selects the correct menu on the first try,' 'User can easily correct errors and mistakes made,' 'User makes few errors and mistakes,' and 'User successfully completes the task,' are all observed in each task in the test scenario. For

each criterion met, failed tasks will be marked ‘no’ for no score, ‘partially’ for a score of 50%, and ‘yes’ for a score of 100%.

According to the observations, users struggled with tasks 3 and 4, with more than half of them failing to complete the tasks correctly. The assignments requested users to look up the price of a certain product as well as the monthly product history. Based on the data analysis, each user's faults can be described in the table below: According to the analysis, the users accomplished 32 task criteria, each with ten trials, for a total of 320 trials. A total of 208 trials were successful, while 23 were partially successful. There were 89 unsuccessful tasks, which will be discarded because 89 times 0% equals 0. To determine the overall errors for this set of challenges, we utilized the following equation:

$$\begin{aligned} \text{Errors (\%)} &= \text{Yes} + (\text{Partial} \times 0.5)) / \text{Total} \times 100\% \\ &= (208 + (23 \times 0.5)) / 320 \times 100\% \\ &= \mathbf{68.59\%} \end{aligned} \tag{6}$$

According to the calculation on equation (6), the error rate metric ranking obtained through usability testing with ten users yields a success percentage of approximately 68.59%. Figure 6 shows how the error rate can be calculated using the same formula.

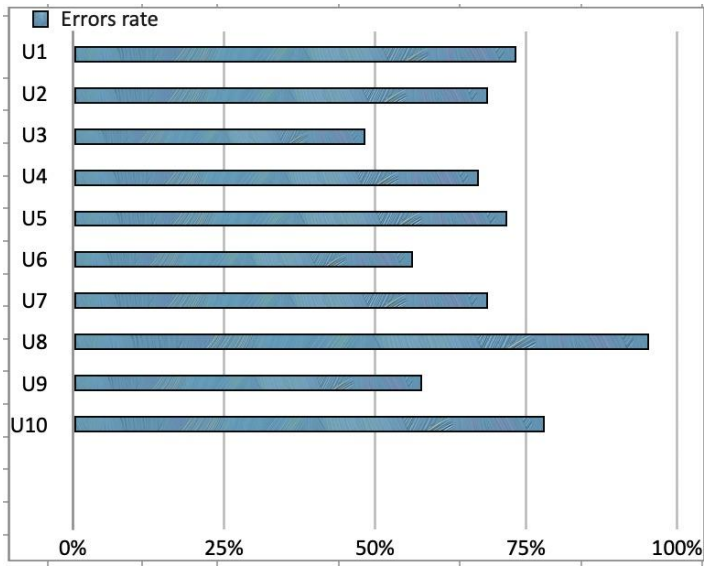

Fig. 6. Error rate each user

3.7 Cognitive Load Metrics

Cognitive Load measurement was conducted by observing and collecting data from each user during the execution of 10 tasks. Cognitive Load in this context refers to the cognitive load experienced by users when completing the tasks given. Cognitive load is measured based on the difficulty of the task perceived by the user, which is rated using a Likert scale (1-5).

The formula for calculating Cognitive Load based on the six dimensions of NASA-TLX is as follows:

Cognitive Load (Total) = Mental Demand + Physycal Demand + Temporal Demand + Performance + Effort + Frustration / 6.

After data from all tasks and all users were collected, the average cognitive load was calculated for each user.

Table 2. Average cognitive load

User	Mental Demand Average	Physical Demand Average	Temporal Demand Average	Performance Average	Effort Average	Frustration Average	Cognitive Load (Total)
U1	3.5	3	3.2	3.5	3.8	3.2	3.36
U2	4	3.5	3.5	4	4.2	3.5	3.78
U3	3	2.8	2.9	3.2	3	2.8	2.95
U4	3.8	3.2	3.5	3.8	3.7	3.2	3.53
U5	4.2	3.5	3.8	4.2	4.5	4	4.03
U6	3.5	3	3.2	3.5	3.8	3	3.33
U7	4	3.7	3.5	4	4.2	3.5	3.81
U8	4.5	3.8	4	4.5	4.7	4.2	4.28
U9	3.7	3.2	3.5	3.8	3.9	3.3	3.56
U10	4.1	3.5	3.7	4.1	4.3	3.8	3.91

In order to calculate the average cognitive load per user using the formula:

$$\text{Cognitive load average} = \frac{\text{cognitive load (total) all tasks}}{\text{number of tasks}}$$

The average result of cognitive load with the NASA-TLX questionnaire for all respondents is 72.72%. These results indicate that the cognitive load experienced by users when using the application is still in the light category.

3.8 Satisfaction Metrics

The System Usability Scale (SUS) post-survey questionnaire is used to test users' satisfaction after they have used the system. Practitioners most often use this questionnaire (Fitria, 2023). A five-point Likert scale was used to organise the questions and responses. The System Usability Scale (SUS) and Likert scale are well paired. This scale has a range of 1 to 5.

Table 3. SUS questionnaire

No	Questionnaire
1	I am confident that I will want to use this system frequently.
2	I believed the system was too complicated.
3	I found the system to be user-friendly.
4	I believe that in order to use this system, I will need the assistance of a technical professional.
5	I found that the system's multiple functions were well integrated.
6	I thought this system has a lot of inconsistent features.
7	Most people should be able to rapidly learn how to use this application.
8	I found it challenging to use the system.
9	I was quite relaxed when using the system.
10	Before I could begin utilizing this tool, I had a lot to learn.

Based on analysis, the result of the satisfaction metrics can be described as figure 7.

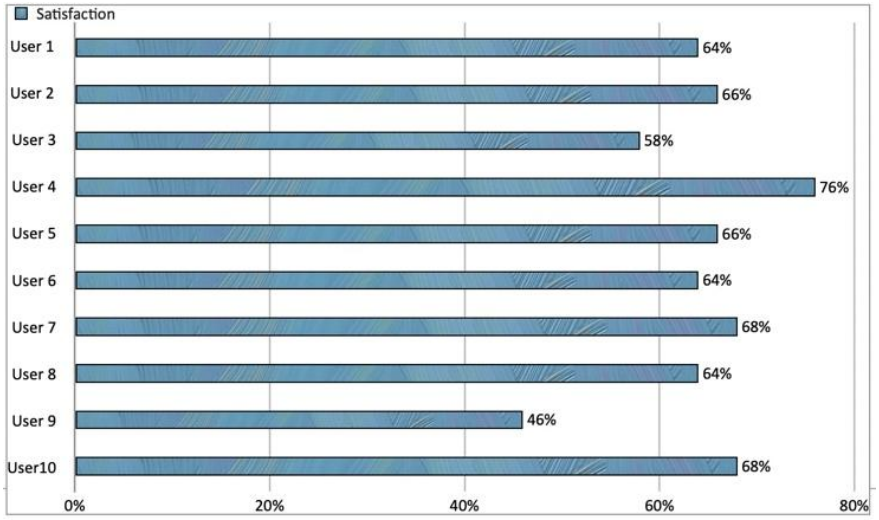

Fig. 7. Satisfaction of each user

In order to get the satisfaction result for the application, the following equation can be used as below:

$$\begin{aligned} \text{Satisfaction (\%)} &= \text{Answer point/Total Point x 100\%} \\ &= (320/500) \text{ x 100\%} \\ &= \mathbf{64\%} \end{aligned} \quad (7)$$

From the analysis result, the satisfaction of 10 users to the panel harga pangan application is about 64%.

3.9 Usability Score

With each usability parameter now represented as a percentage, the metrics are learnability, efficiency, memorability, errors, satisfaction, effectiveness and cognitive load. An index between 1 and 100 is used to represent the usability of the panel harga pangan app by averaging the seven scores.

The following formula can be used to determine the usability score of the panel harga pangan app for all users:

$$\begin{aligned} \text{Usability (\%)} &= (\text{ Learnability + Effectiveness + Efficiency + Memorability + Errors + Cognitive Load + Satisfaction}) / 7 \\ &= (65.78 + 62.5 + 73.27 + 70.93 + 68.59 + 72.72 + 64) / 7 \\ &= \mathbf{68.25\%} \end{aligned}$$

The results of data analysis show that the usability score received after the measurement of seven metrics which are learnability, efficiency, memorability, errors, satisfaction, effectiveness and cognitive load is about 68%. This an assessment range of 65 - 84 with the usability category falls to being acceptable to users.

3.10 Prototype Model

The prototype model has been developed to improve the current design of the application. The prototype to similar application is figured as shown on Fig. 8.

The prototype model of the similar application has been developed based on the analysis of PACMAD model. The suggestion prototype offers the application not only observe the agriculture food price but also buy the product. The application will allow user to conduct the transaction online.

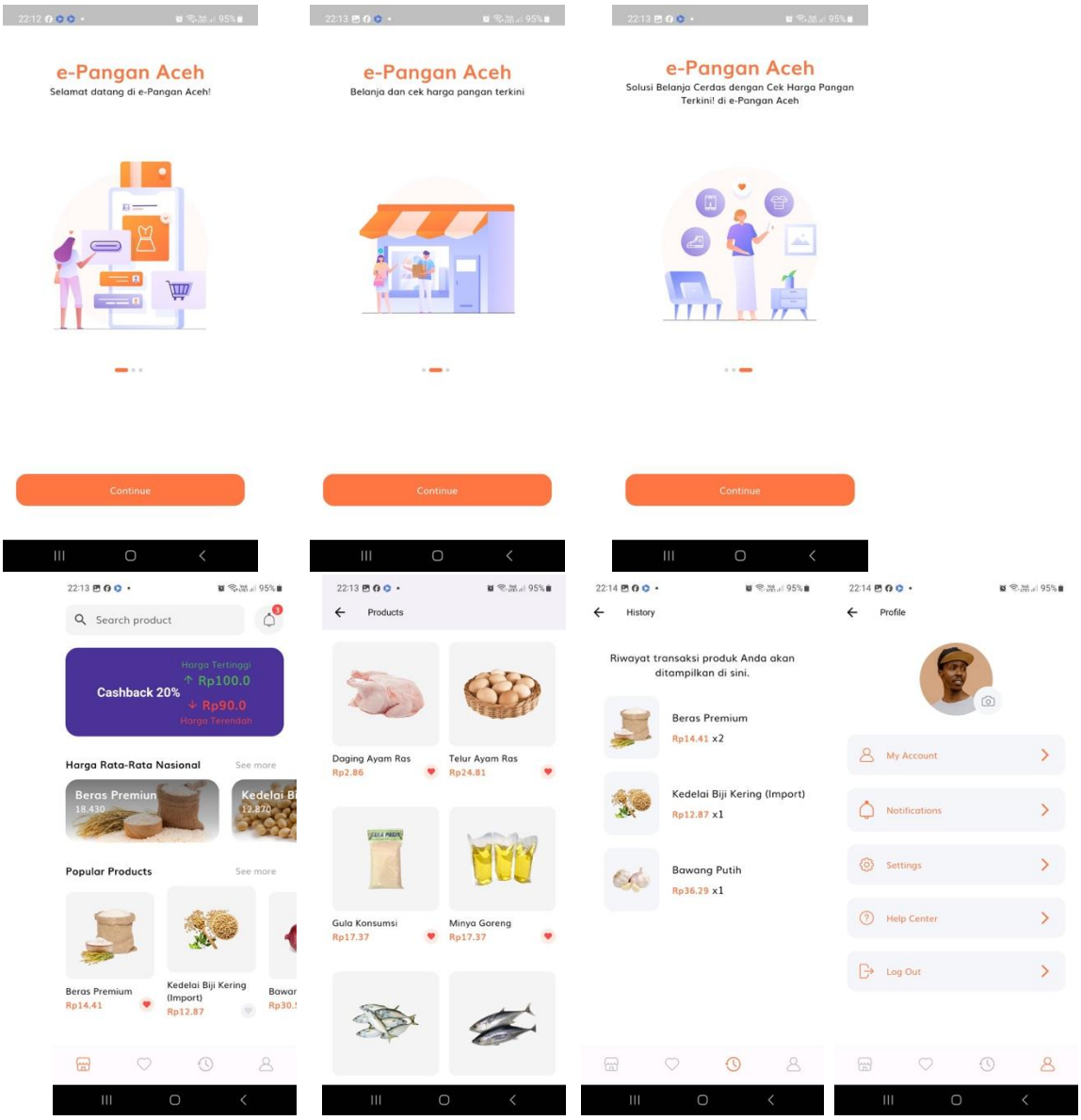

Fig. 8. The prototype model

4. Conclusion and Recommendation

The *Panel Harga Pangan* application was evaluated by ten users for usability in the current study. The major outcomes of this study demonstrated that user perception is a challenging issue when conducting user testing with individuals from diverse backgrounds. These findings align with the research of (Agustiono et al., 2023), in which users discovered that the design of the application should enhance user satisfaction and ease of use. In addition, the usability testing of this application has been also conducted by applying Nielsen metrics (Fitria et al., 2024). The application's results show that while some users found it easy to use, others found it difficult to complete the set of tasks. This focus can help improve the overall user experience and increase the likelihood of user retention. This research identified several usability issues, including inconsistent data in location selection, intermittent submenu (filter menu) behaviour, difficulty in understanding 60% of user assessments, non-functional edit profile buttons, and a lack of error message indicators. Additionally, users noted a lack of visual feedback when performing specific actions, which contributed to confusion and frustration. These flaws will be addressed with recommendations for future development of similar

applications. This usability measurement closely aligns with the seven parameters of learnability, efficiency, memorability, error rate, satisfaction, effectiveness, and cognitive load. In other words, the observation, satisfaction questionnaire results, and cognitive abilities are all strongly correlated. The *Panel Harga Pangan* has an average usability score of 68%, indicating certain issues encountered by users during the evaluation. While some users found the application easy to use, others struggled to complete the provided test case. Additional testing and expert evaluation are needed to validate the results utilizing the PACMAD model theories. Moreover, implementing user-centered design strategies, such as interactive wireframes and clickable prototypes, will allow for early feedback and iterative improvements (Nada & Indriyanti, 2022). Further research should include interviews with key individuals who can openly express their opinions. It is highly encouraged to engage users in sketching out the required prototype design as planned. Using more advanced tools, such as eye-tracking technology, can lead to more reliable and detailed results.

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