

User Experience Analysis on e-Wallet Using a Combination of Heuristic Evaluation and UMUX

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Abstract — Usability is the level of ease of users in using the interface on a system. Usability can be measured using expert judgment or user testing. One of the techniques in usability measurement that can be is Heuristic Evaluation (measured by the expert) and Usability Metric for User Experience or as known as UMUX (measured by user). Heuristic Evaluation is an interface evaluation process that aims to measure an interface's usability, efficiency, and effectiveness based on ten heuristic rules.

Meanwhile, UMUX is a short-level instrument method or rating level used to collect quantitative user data about the usability of an application. Therefore, the combination of expert judgment and user assessment will provide rich and complementary findings. In this study, we used "CARDS" as the research object. "CARDS" is a digital card application or e-wallet used to pay bills, top-up card balances, online stores, and Payment Point Online Banks. This study aims to improve the quality of service to users of the "CARDS" application by testing the user experience. The result shows that the UMUX score is not equal to 74, so it is necessary to make improvements, with recommendations from experts by the Heuristic Evaluation method based on the lowest assessment score, namely the Consistency and Standards category.

Key Words : E-Wallet, Heuristic Evaluation, UMUX, User Experience, User Satisfaction.

I. INTRODUCTION

"CARDS" is a digital card application that is used to pay bills, top up card balances, online stores, to Payment Point Online Banks. "CARDS" are usually used by educational institutions or companies as employee identity cards that are integrated with digital payments[1]. "CARDS" has never been tested for user experience, so it needs to be tested, so that it can be used as material for recommendations for further design improvements. One way to measure user satisfaction is by doing usability testing. Usability is the level of user convenience in using the interface on a system [2].

Usability can be measured using expert judgment or user testing. In this research, expert judgment used the Heuristic Evaluation method. HE is an interface evaluation process that aims to measure the usability, efficiency and effectiveness of an interface based on ten Heuristic Evaluations[3]. As for user testing in this study using the UMUX method, where the UMUX method is a short-level instrument method or with a rating level used to collect quantitative user data about the usability of an application[4]. Based on recent studies revealed that the effectiveness of user evaluation can also be combined with a questionnaire[5].

To get the results of comprehensive usability testing, it is necessary to do a test using a combination of assessments from experts and users. The combination of methods used is the Heuristic Evaluation method and the UMUX method. The selection of the Heuristic Evaluation method is due to using 10 Nielsen principles in the study. As well as using the UMUX method to collect quantitative user data about usability testing. The combination of these methods involves several respondents according to the testing method. The Heuristic Evaluation method involves expert respondents in the fields of usability, fintech, and software engineering. While the UMUX method involves students of Vocational High School NU Maarif 1 Purwokerto as respondents from active users of the "CARDS" mobile application. This research aims to improve the quality of service to users of the "CARDS" mobile application.

II. LITERATURE REVIEW

A. User Experience

User experience is the involvement of users in interacting with the interface of a product or system that has an interesting user experience and can be observed or measured [3]. User experience is considered as something dynamic, where a person's internal and emotional conditions can change when interacting with the product or after using the product [4].

B. Heuristic Evaluation (HE)

Heuristic Evaluation is the process of evaluating the interface by one or more experts or professionals. The purpose of Heuristic Evaluation is to fix every part of the design of the object under study effectively. The evaluator carries out the evaluation process through a set of performances that have been determined from a series of tasks by design and adjusted to the criteria for each level of these tasks [6].

TABLE I. NIELSEN'S USABILITY HEURISTIC

No	Heuristic	Definition
1	H1-Visibility of System Status	The system must always keep users informed of what is happening, through good and timely messages.
2	H2-Match Between System and the Real World	Words, phrases, general concepts that are easy to understand are one of the parts of the system that users can understand.
3	H3-User Control and Freedom	Users can freely choose and perform work (as needed) when accessing the system.
4	H4-Consistency and Standards	The system becomes standard and consistent in terms of writing sentences, fonts, and so on so that users do not need to be confused by different situations and actions on the system.
5	H5-Error Prevention	Designing a feature to prevent and minimize user errors.
6	H6- Recognition Rather Than Recall	The system helps the user to reduce remembering from every process that has been passed or carried out because it has been clearly informed by the system
7	H7- Flexibility and Efficiency of Use	The system makes it easy for new users and experienced users to be comfortable in accessing the system.
8	H8-Aesthetic and Minimalist Design	The system displays information or descriptions that are relevant to the intent of the selected menu.
9	H9-Helps User Recognize, Diagnose, and Recovers User	The system displays error messages that occur clearly to the user.
10	H10-Help and Documentation	The system must have a help menu and helpful documentation as a guide for the user when using the system

C. UMUX (Usability Metric for User Experience)

UMUX (Usability Metric for User Experience) is a short-level or rating-level instrument method used to collect quantitative user data about the usability of an application. The testing process is carried out by giving respondents 4 questions where each question will be given a level or rating from 1 to 7, 1 means "strongly disagree" while 7 means "strongly agree" [7].

The calculation formula for the test score using the UMUX method can be seen in the equation (1)

TABLE II. UMUX QUESTION STANDARD

No	Question	Score						
		1	2	3	4	5	6	7
1	This system's capabilities meet my requirements							
2	Using this system is a frustrating experience							
3	This system is easy to use							
4	I have to spend too much time correcting things with this system							

$$UMUX\ Score = \frac{[Q1-1]+[7-Q2]+[Q3-1]+[7-Q4]}{24} \quad (1)$$

In the above equation Q is the question variable. UMUX has 4 questions, where Q1 is the first question, Q2 is the second question, Q3 is the third question, and Q4 is the fourth question from UMUX. So that the calculation can be done using the formula, each odd item is given a score [user score - 1] and each even item is given a score [7 - user score] then add up the score and divide by 24 and multiply by 100 [8].

D. E-Wallet

An electronic wallet (e-wallet) is a wallet that is connected to a server in the form of a mobile application to store a certain amount of money to be used anytime and anywhere as long as there is a suitable payment service. Digital wallets make transactions easier because with this, users don't need to carry large amounts of money, but only need to top up the e-wallet installed on their cellphone with an internet connection. Payments can be made easily, namely non-cash transactions[9].

E. CARDS

"CARDS" is a digital card application that is used to pay bills, top up card balances, online stores, to Payment Point Online Banks. "CARDS" can be used by educational institutions as student and staff/teacher/employee identity cards that are integrated with digital payment systems, easy and safe. Besides being able to be used by educational institutions, "CARDS" can also be used as payment cards at tenants/outlets/merchant, which can also be used for integrated employee cards[1].

III. RESEARCH METHODOLOGY

A. Subject and Object of Research

The subjects of this study were divided into two, namely respondents for the Heuristic Evaluation method and respondents for the UMUX method. Respondents for the Heuristic Evaluation method amounted to 6 respondents. With 4 fields of evaluator, namely in the fields of usability, software engineering and fintech, with each respondent in each field totaling 2 respondents. The choice of the number of respondents is caused by the more number of respondents in the Heuristic Evaluation, it will cause many problems [9]. The UMUX method uses 94 respondents from Vocational High School NU 1 Ma'arif Ajibarang students with an age range of 16-17 years. The number of respondents was obtained based on the results of calculations from the Taro Yamane formula [11]. The calculation formula can be seen in the equation (2)

$$n = \frac{N}{N \cdot d^2 + 1} \quad (2)$$

Description :

number of samples (n), total population (N), specified precision (10% accuracy limit) (d).

The object of this research is to examine user satisfaction in using the "CARDS" application.

B. Tools and Materials

The tools needed in this research are Smartphones and Laptops. While the materials used are the "CARDS" application, the UMUX questionnaire, the Heuristic Evaluation questionnaire.

C. Research Flow

The research process begins with conducting a literature study process related to cashless, user experience, UMUX, Heuristic Evaluation. Furthermore, the data collection process uses two methods. Data collection using the UMUX method with student respondents from Vocational High School NU 1 Ma'arif Ajibarang. In collecting data at UMUX there are several stages, starting with a confidentiality agreement, followed by a pre-test of the questionnaire and continued with the implementation of tasks, after that a post test is carried out to find out the final results of the UMUX test.

The next data collection is by using the Heuristic Evaluation method with expert respondents. Data collection involves experts starting with determining the usefulness of heuristics. Then proceed with the evaluation process based on the heuristic problem and finally determine the severity of the heuristic problem. After collecting data with a combination of two methods, then the data will be processed by calculating the usability value. The next step is to analyze the results of the usability calculation. After doing the analysis, it can be concluded from this study whether the usability of the "CARDS" application has met user satisfaction standards or not. The research flow can be seen in the Figure 1.

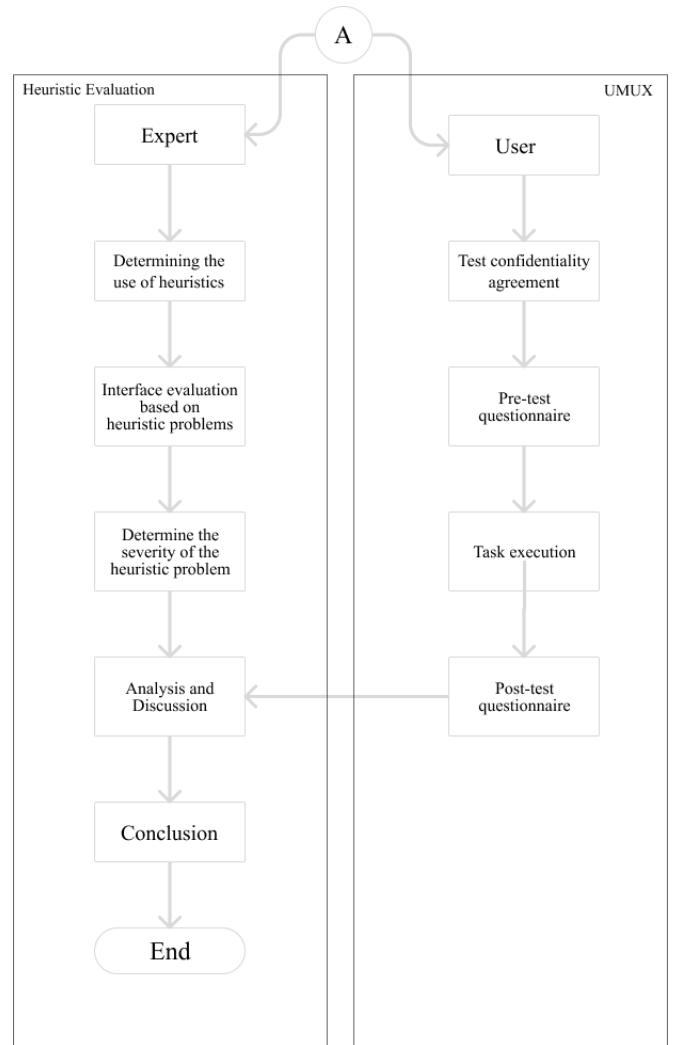
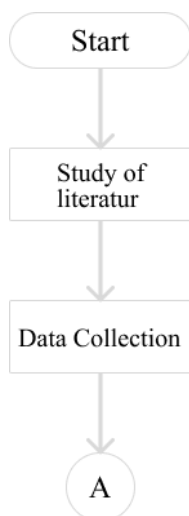


Fig. 1. Research Flow

IV. ANALYSIS AND DISCUSSION

A. Analysis Heuristic Evaluation

Heuristic Evaluation method to get the average value of each aspect using the equation, can be seen in (3)

$$SR = \frac{0(x_1) + 1(x_2) + 2(x_3) + 3(x_4) + 4(x_5)}{N} \quad (3)$$

Description :

SR average of each item; x_1 is frequency scale 0; x_2 is frequency scale 1; x_3 is frequency scale 2; x_4 is frequency scale 3; x_5 is frequency scale 4; N is the number of usability sub-aspects in each usability aspect. After distributing the questionnaires and calculating severity ratings, the results are shown in the Fig. 2.

Based on the problems from the questionnaire questions, consolidation was carried out with the experts to verify the problems and recommendations from the problems. The results of the consolidation will be used as guidelines in the development of the "CARDS" mobile application so that it is expected to improve the performance of the application.

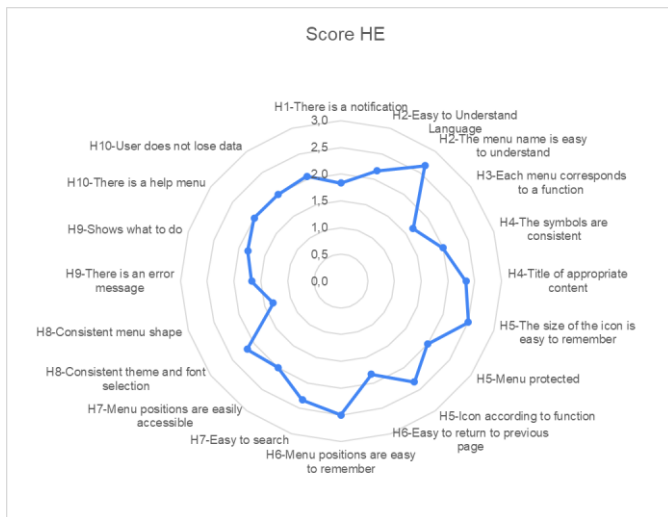


Fig. 2. Severity Ratings

In the recapitulation there are the highest number of findings in the problem, namely the Error Prevention aspect with each question item getting an average value of 2.0, so it is included in the category of minor usability problems, with fixing this problem given a low priority. The recapitulation table can be seen at Table III.

While the discovery of the least problems is in the aspects of Visibility of System Status and User Control and Freedom with each average value of 1.8 or can be rounded up to 2.0 and 1.3 can be rounded up to 1.0. So that the Visibility of System Status aspect can be categorized as a minor usability problem, with fixing this problem given a low priority. Meanwhile, aspects of User Control and Freedom can be categorized as cosmetic problems, namely problems that do not need to be fixed unless there is time left in project work.

TABLE III. PROBLEM RECAPITULATION

Nielsen's Heuristic Principal	Problem	Score SR
Visibility of System Status	1	1.8
Match Between System and the Real World	2	1.9
User Control and Freedom	1	1.3
Consistency and Standards	2	2.5
Error Prevention	3	2.2
Recognition Rather Than Recall	2	2
Flexibility and Efficiency of Use	2	2.1
Aesthetic and Minimalist Design	2	2.1
Helps User Recognize, Diagnose, and Recovers User	2	2.4
Help and Documentation	2	1.9
Total	19	2.02

Based on the value of Severity Ratings in Table III, it gets a value of 2.02, which is included in the category of minor usability problems, which means that problem repairs are given low priority.

B. UMUX Analysis

After distributing the UMUX questionnaire, the researchers got 94 students as respondents. After distributing

the questionnaire, then the next step is to calculate the score based on the results of the respondents' answers to the questionnaire.

C. UMUX Calculation

Based on the equation (1), get the calculation results in the Table IV.

TABLE IV. UMUX CALCULATION RESULTS

Respondent	Q1	Q2	Q3	Q4	Total	Score umux
R1	7	5	6	5	23	63
R2	7	6	7	5	25	63
R3	6	4	5	3	18	67
R4	5	3	4	5	17	54
R5	7	5	7	5	24	67
R...
R94	7	4	6	5	22	67
Average						63

D. Validity test Pearson

Validity test developed by Pearson on usability testing on the "CARDS" mobile application using 4 aspects of UMUX questions. The aspect score used will be correlated with the total score so that it can be used to test the validity of each aspect. An item will have high validity if the score has great support for the total score. Each item is stated in the form of a correlation so that to get the validity of an item, the correlation formula is used. The interpretation of the magnitude of a correlation coefficient can be seen in Table V.[11].

TABLE V. CORRELATION COEFFICIENT

Correlation coefficient	Interpretation
$0.8 < r_{xy} \leq 1$	Very High
$0.6 < r_{xy} \leq 0.8$	High
$0.4 < r_{xy} \leq 0.6$	Enough
$0.2 < r_{xy} \leq 0.6$	Low
$r_{xy} \leq 0.2$	Very Low

After knowing the results of the correlation or the value of r_{count} and r_{table} value. Then the validity test decision is then made with the following conditions [12]:

- If $r_{count} \geq r_{table}$, then the data is valid
- If $r_{count} \leq r_{table}$, then the data is invalid

The results of the validity test are obtained as in Table VI.

TABLE VI. PEARSON VALIDITY TEST RESULTS

Question	R _{count}	df	r _{Table}	Category	Description
1	0.745	93	0.207	High	VALID
2	0.790	93	0.207	High	VALID
3	0.727	93	0.207	High	VALID
4	0.770	93	0.207	High	VALID

Based on the calculation results, the four question items in the UMUX questionnaire have a value of $r_{\text{count}} \geq r_{\text{table}}$, so that it can be declared valid.

E. Cronbach Alpha Reliability Test

The Cronbach Alpha reliability test has the aim that the data measurement tool in this study can be trusted so that it gets stable and consistent results. The low reliability is indicated by a number that can be called the reliability coefficient. The higher the measurement results, the higher the level of reliability coefficient, the magnitude of the coefficient r is calculated with a range between 0 to 1 [13].

In this research, the criteria for determining reliability used the 0.70 standard. The results of the calculation of the Cronbach Alpha value get a value of 0.746 so that it can be concluded that the data used is reliable. The results of the reliability calculation can be seen in Table VII.

TABLE VII. RELIABILITY TEST

Reference Value	Cronbach's Alpha Value	N of Items	Conclusion
0.7	0.746	4	Reliable

F. Heuristic Evaluation Results

By using One-Sample T-Test, it is found that the value of t (t count) is -9,224. The value of df (degree of freedom) or degrees of freedom is 5. The value of Sig. (2-tailed) or the significance value with a two-tailed test is 0.000 which is shown in Table VIII.

TABLE VIII. ONE-SAMPLE TEST HE

One-Sample Test						
Test Value = 3						
	t	df	Sig.	Mean Difference	95% Confidence Interval of the Difference	
			(2-tailed)		Lower	Upper
Score HE	9.224	5	0	-0.98	-1.2204	-0.7396

So that the result is that the significant value is 0.000 by using the test value of 3 which shows this significant number is smaller than 0.05, the hypothesis in this study is obtained is H_0 is rejected, therefore H_1 is accepted where it can be described that the average usability value of the application mobile "CARDS" is not equal to 3.

G. UMUX Result

By using One-Sample T-Test, it is found that the value of t (t count) is 102,302. The value of df (degree of freedom) or degrees of freedom is 93. The value of Sig. (2-tailed) or the significance value with a two-tailed test is 0.000 which is shown in Table IX.

So that the result is that the significant value is 0.000 by using a test value of 74 which shows this significant number is smaller than 0.05, the hypothesis in this study is obtained is H_0 is rejected, therefore H_1 is accepted where it can be

TABLE XI. ONE-SAMPLE TEST UMUX

One-Sample Test						
Test Value = 74						
	t	df	Sig.	Mean Difference	95% Confidence Interval of the Difference	
			(2-tailed)		Lower	Upper
Score UMUX	102.302	93	0	62.36638	61.1558	63.57

described that the average usability value of the application mobile "CARDS" is not equal to 74. Based on the analysis at each stage, the obtained value is not equal to 74, so improvements need to be made, with recommendations from experts based on the lowest assessment score, namely the Consistency and Standards category.

V. CONCLUSION

Based on the results of research on user experience analysis on the "CARDS" mobile application using the Heuristic Evaluation and UMUX methods, the following conclusions are obtained :

1. Based on the research using the Heuristic Evaluation method, the data that has been processed using the One-Sample T-Test can be concluded that the average value of the Heuristic Evaluation score is 2.02. With a minor usability problem category level, which means that fixing this problem is given a low priority. The highest level of problem is in the Consistency and Standards category.
2. Based on the research using the UMUX method, the data that has been processed using the One-Sample T-Test can be concluded that the average score is 63.11, with a reliability level of 0.746. So that the data used is quite reliable in this study. Because it has not met the standard of user satisfaction, the "CARDS" mobile application needs to make improvements according to suggestions such as increasing the respondent population.

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