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The Relationship between Usability and User Experience on User Interface Design of Smart Grid Mobile Applications

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Abstract: The balance between usability and user experience in a mobile app user interface design is important. In addition to being easy to use, the application also needs to have an attractive design for use by users. In this study aims to determine the relationship between usability and user experience on the design of user interface design smart grid mobile applications. Usability testing uses System Usability Scale (SUS) and user experience testing using User Experience Questionnaire (UEQ). The result of testing the relationship between usability with user experience got the value of 0.603. The value of 0.603 included into relationship level "strong".

Keywords: Usability, User Experience, User Interface Design, Smart Grid, Mobile Applications

I. INTRODUCTION

Making the design of the user interface on mobile applications does not focus only on the design. The Design also needs to pay attention to other things like usability aspect. The usability aspect of mobile applications has become an important element and needs to be identified to gain success in the market [1][2]. The goal is to make sure that the created apps can be used and satisfy the users [2]. In general, usability aspect leads to ease of use in an application [2].

Another aspect to consider in designing user interfaces other than usability aspects is the aspect of user experience. User experience is different when compared to usability [3]. User experience is more related to user emotion or interest [3]. Not only has a good usability aspect, mobile apps also need to have a good user experience aspect as well.

After designing the user interface, to find out whether or not the design needs to be tested such as usability testing and user experience testing. Testing usability to see the level of ease of use of this application. While testing the user experience to see the level of user interest when using this application

In the usability testing process and user experience testing not only ends in the results alone, but it needs to be seen how the relationship between the test results of both. Previous research [4] which tests usability and user experience does not do so. So in this study, will conduct an analysis of the relationship of usability testing results and user experience testing on the design of mobile interace user applications but in different cases. Design user interface that will be analyzed level of relationship between usability and user experience, which is user interface design smart grid mobile application.

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Smart grid is a concept of electrical network modernization that facilitates the control of electricity usage [5]. In the future, monitoring of energy consumption and controlling electrical power can be done remotely using a mobile device or smartphone [6]. But now, it is still in the stage of further research, especially in Indonesia.

Some research on the development of mobile smart grid applications that exist today, namely research [6] which focus only on the monitoring of energy consumption alone. Then research [7], its development has reached the stage of monitoring, regulating, and scheduling energy sources. To continue the existing research, in this research design the user interface design on smart grid mobile application specially on process of buying and selling electricity.

Smart grid mobile application in this research is an application that will be used by electric customers to buy electric power. In addition, electricity customers sell their electrical power from private power generators. Electric customers will also be able to monitor their expenses and revenues from electricity consumption. It can be said that this smart grid mobile application is a modernization in terms of purchasing and selling electrical energy.

After doing the design of user interface design, then proceed with usability testing process and user experience testing by the respondent. Testing usability using System Usability Scale (SUS) and user experience testing using User Experience Questionnaire (UEQ).

The results of data collection, then analyzed the level of relationship between usability and user experience. The purpose of this analysis or research to see how the relationship between usability testing results with the results of user experience testing on smart grid mobile applications. With this research, will be known the quality of the design design user interface application.

II. Literature Review

A. *User Interface Mobile Applications*

The user interface is a blend of graphic elements and navigation systems [8]. The user interface is effective to make the user focus on the objects and subjects seen better [9]. Unlike desktop devices, user interaction with mobile devices must be designed so that the user's action span is shorter than on desktop devices, the action should be simple but focused [10]. In addition to different desktop devices, designing a user interface design also has limits such as mobile context, connectivity, small screen size, different display resolution, limited processing capability and power, and data entry methods [11]. So the design process of the user interface is really through the correct procedure.

The procedure in designing user interface design of android mobile application is divided into 3[12], performing needs analysis, designing user interface and software engineering (implementation of user interface). The sequence of the design procedure is shown in Fig 1.

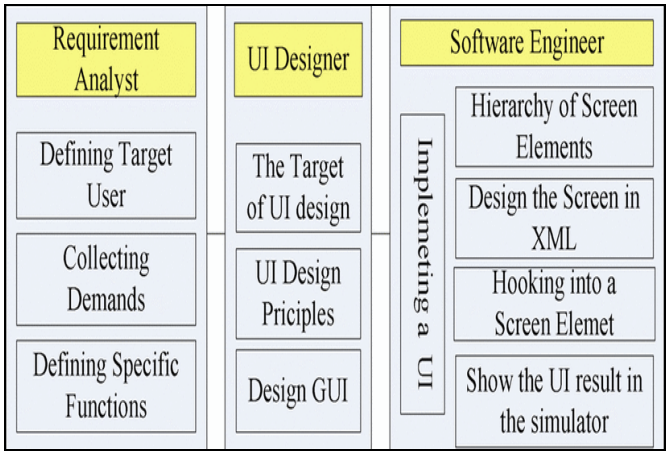

Fig 1. UI android mobile application UI design procedure [12]

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The design results obtained through the correct procedure can then be tested. Testing on user interface design aims to assess the quality of the design design. Some tests on commonly used designs such as usability test and user experience test.

B. Usability

Definition of usability according to ISO 9241-11 international standard[1], usability is the extent to which a product can be used by a particular user to achieve a defined target with effectiveness, efficiency and satisfaction. Meanwhile, according to Jacob Nielson defines usability as the ability of the system to meet the needs of users with 5 attribute assessment, namely learnability, efficiency, memorability, errors, and satisfaction [11][2]. In general, usability aspect leads to ease of use in an application [2]. How easily an design of user interface applications can be used by users. In addition, the main focus of usability is also on how the user interface design can be used to complete tasks well and smoothly.

In this study usability testing using System Usability Scale (SUS). SUS is the simplest and most reliable questionnaire [13][14]. The best usability testing is with the use of SUS [13][14]. SUS developed by John Brooke, is a reliable, popular, effective and inexpensive usability scale that can be used for global assessment of system usability [14][15][16]. SUS to be used as in Table 1.

Table 1. Item SUS [17]

No	SUS
1	I think that I would like to use this system.
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 the 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.

C. User Experience

User experience is an important factor to determine whether an information is adequate enough acceptance by users [18]. User experience focuses on measuring the level of user acceptance of the application [19]. User experience is different when compared to usability [3]. User experience is related to user emotion or interest [3]. So how does a user interface design provide an exciting and fun experience. UEQ contains 6 rating scales [20], attractiveness, perspicucuity, efficiency, dependability, stimulation, and novelty.

To test user experience quickly and simply can using User Experience Questionnaire (UEQ)[21]. UEQ is an easy and efficient tool or questionnaire to measure the user experience [4]. UEQ has 26 questions and has 7 answer choices. The answers range from the negative to the positive. UEQ to be used as in Fig 2.

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	1	2	3	4	5	6	7		
annoying	○	○	○	○	○	○	○	enjoyable	1
not understandable	○	○	○	○	○	○	○	understandable	2
creative	○	○	○	○	○	○	○	dull	3
easy to learn	○	○	○	○	○	○	○	difficult to learn	4
valuable	○	○	○	○	○	○	○	inferior	5
boring	○	○	○	○	○	○	○	exciting	6
not interesting	○	○	○	○	○	○	○	interesting	7
unpredictable	○	○	○	○	○	○	○	predictable	8
fast	○	○	○	○	○	○	○	slow	9
inventive	○	○	○	○	○	○	○	conventional	10
obstructive	○	○	○	○	○	○	○	supportive	11
good	○	○	○	○	○	○	○	bad	12
complicated	○	○	○	○	○	○	○	easy	13
unlikable	○	○	○	○	○	○	○	pleasing	14
usual	○	○	○	○	○	○	○	leading edge	15
unpleasant	○	○	○	○	○	○	○	pleasant	16
secure	○	○	○	○	○	○	○	not secure	17
motivating	○	○	○	○	○	○	○	demotivating	18
meets expectations	○	○	○	○	○	○	○	does not meet expectations	19
inefficient	○	○	○	○	○	○	○	efficient	20
clear	○	○	○	○	○	○	○	confusing	21
impractical	○	○	○	○	○	○	○	practical	22
organized	○	○	○	○	○	○	○	cluttered	23
attractive	○	○	○	○	○	○	○	unattractive	24
friendly	○	○	○	○	○	○	○	unfriendly	25
conservative	○	○	○	○	○	○	○	innovative	26

Fig 2. Item UEQ [22]

III. PURPOSE WORK

A. *Participants*

The collection of data on testing usability and user experience on the mobile application user interface design smart grid using SUS and UEQ given to 20 respondents. Determination of the number of respondents to be used in this study is based on research [13], namely the amount of 20 issues tested respondents would approach 95% level of confidence. In other studies, such tests required a minimum sample size of 12-14 participants for reliable results [23]. Respondents who numbered 20, will be divided into 2 groups, namely: (1) 10 male respondents; and (2) 10 female respondents. Data collection on respondents using random sampling technique or taken at random.

B. *Instruments*

In this study instrument usability testing used is, System Usability Scale (SUS). SUS has 10 question components and 5 answer choices ranging from strongly disagree to strongly agree and have a minimum score of 0 and a maximum of 100[16]. Furthermore, to test user experience in this study using the instrument of User Experience Questionnaire (UEQ). UEQ contains 6 rating scales [20], namely: attractiveness, clarity, efficiency, precision, stimulation and novelty. UEQ itself has 26 question components and 7 answer choices.

C. *Analisis Data*

After the data obtained from the test using SUS instrument and UEQ instrument, then we analyzed the relationship between SUS instrument data with UEQ instrument data. Stages of this analysis using a simple correlation test. Correlation test used is bivariate pearson correlation. The testing process uses statistical applications as a calculation tool. From this analysis we can see the value of coefficient interval between usability and user experience in mobile smart grid application. To determine the level of relationship between SUS and UEQ results will follow the assessment guidelines as in table 2.

Table 2. Interpretation of correlation [24]

Interval coefficient	Correlation
0,00 – 0,199	Very Low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	Strong
0,80 – 1,000	Very Strong

Then the instrument reliability test will be performed. The reliability test is performed to determine whether the instrument can be used more than once or more precisely the internal consistency test [25]. The reliability test in this study used cronbach's alpha test. The testing process uses the help of statistical applications. The results of reliability testing will get the value

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of cronbach's alpha. Then can be determined the assessment of data results from SUS using table 3.

Table 3. Alpha value [25]

Cronbach's alpha value	Rating
α > 0,9	Excellent
α > 0,8	Good
α > 0.7	Acceptable
α > 0,6	Questionable
α > 0,5	Poor
α < 0,5	Unacceptable

IV. Results and Discussion

This smart grid mobile application was a modernization concept in terms of purchasing and selling electric power in Indonesia. The function of mobile smart grid application was divided into 3, as follows:

1) Smart grid mobile applications allow users to purchase electricity from their chosen power source. Users can also purchase electrical power within a certain time span, ranging from a few hours to several days. In addition, users can also limit the power to be purchased within a certain time span of a purchase.
2) Smart grid mobile applications allows customers to sell electricity from their own power plant. Users can also sell electrical power within a certain time range, ranging from a few hours to several days. Before conducting a sales transaction, the user can find out the estimated revenue from a power source that wants to sell for a day. In addition, users can also limit the power to be sold within a certain sales time range.
3) Users can also monitor expenses from purchasing electrical power. In addition, users can also monitor the revenue from the electrical power they sell. Expense and income information can be viewed in the time span of days, weeks, months and years.

Furthermore, the display prototype mobile application user interface design smart grid will be tested the relationship between usability and user experience such as the following to design the home page.

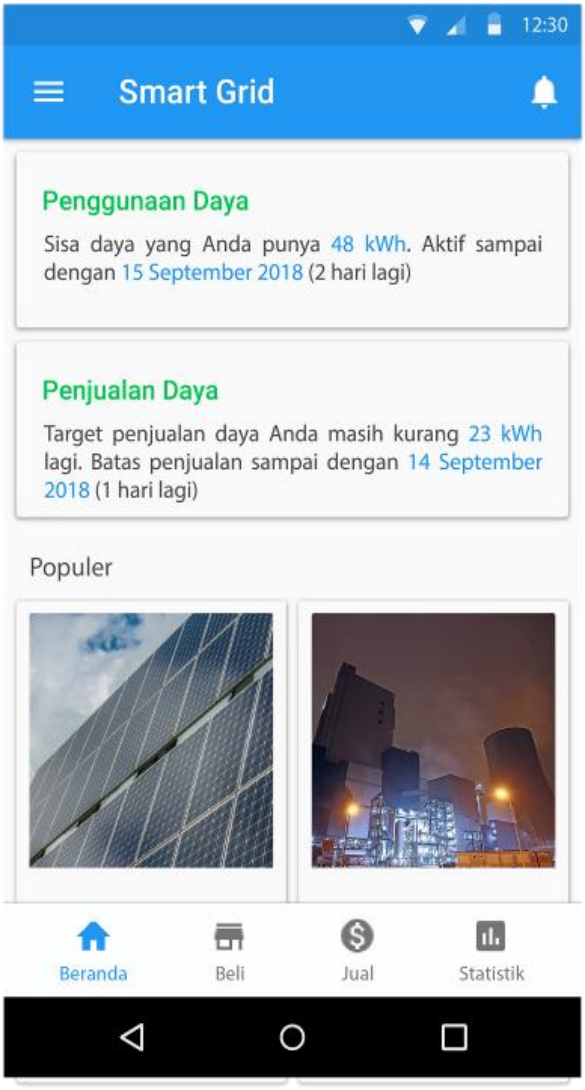

Fig 3. Design user interface mobile application smart grid on home

Then to design the user interface on the purchase details shown as in the following Fig 4.

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Fig 4. Smart grid mobile application user interface design on buy details

Furthermore, the user interface design on the transaction process is shown as in the following Fig 5.

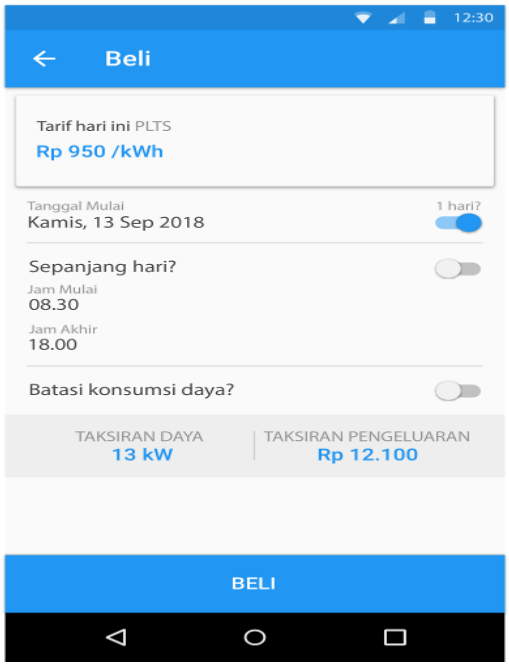

Fig 5. Smart grid mobile application user interface design on transaction processing

After the data obtained from the test usability and user experience then performed a simple correlation test. Simple correlation testing using statistical applications. The result of simple correlation between usability test result with user experience test result got value 0,603. Based on the interpretation of correlation table, the value of 0.603 falls into the "strong" relationship level. Between usability and ux get significance value 0.005 <0.01 which means there is a significant correlation between the two. The results of the correlation test as in Fig. 8 below.

Correlations

		Usability	UX
Usability	Pearson Correlation	1	.603**
	Sig. (2-tailed)		.005
	N	20	20
UX	Pearson Correlation	.603**	1
	Sig. (2-tailed)	.005	
	N	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

Fig 6. Correlation test results

Correlation test results are included in the level of "strong" relationship. Despite entering into a strong relationship level, the value obtained approaches the lower limit of the strong relationship level and also approaches the upper limit of the moderate level of relationship. The results of this relationship level can be considered reasonable. Between usability assessment with user experience the direction of the goal slightly different.

Testing the usability of the end result to show that a design can be used well. Testing user experience the end result to show ketertatikan on a design. It could be good usability results, but the user experience was less good or usability results are less good, but the user experience good results. This can happen if a design can be used properly but the display design is less attractive or a design

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difficult to use well but the design look very attractive.

V. Conclusion

In this research, we analyzed the relationship between usability testing result and user experience test result on smart grid mobile application user interface design. The results of this study indicate that the relationship between usability testing results with user experience test results got a "strong" relationship level. But there was still a need to improve on the design so that the relationship between usability and user experience on this design was really strong.

Design of user interface design of smart gird mobile application should pay attention to balance usability and user experience. Smart gird mobile application user interface design not only can be used well by the user, the user interface design view also provides an interesting experience. Because ultimately a useful application and provide an interesting experience that will be used continuously by the user.

VI. Future Work

Further research needs to do the balancing result between usability with UX because in this research the result has not really balanced. In addition, this research only until the stage of making prototype and testing, in the future need to make improvements in terms of design and use of data.

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