

Improvement I-Gracias Mobile Website Using User Centered Design (UCD) Methods

1st Mohamad Ichwan Arrasid
Faculty of Informatics

Telkom University
ichwanarrasid@students.telkomuniver
sity.ac.id

2nd Gede Agung Ary Wisudiawan
Faculty of Informatics

Telkom University
Bandung, Indonesia
degunk@telkomuniversity.ac.id

3rd Shinta Yulia Puspitasari
Faculty of Informatics

Telkom University
Bandung, Indonesia
shintayulia@telkomuuniversity.ac.id

Abstract

At this time the growth of technology has increased rapidly to encourage the development of mobile technology. Today mobile phones have become the gadgets that are most often used. It was stated that Indonesia is one of the countries that access the internet the most and it is predicted that 67% of connections are accessed via mobile devices. In this case, the integrated academic information system Telkom University website (I-Gracias), has a fairly serious problem when accessed via a special smartphone device on the TA/PA menu, many students complain about existing problems. The user interface design pattern method was applied to define problems and provide concrete design solutions to solve existing problems. To find user habits and needs, the User Centered Design method is applied which focuses on the product from the user's point of view, user needs, user habits, and user experience. The results of this research the mobile version of the menu TA/PA which received a good response from students, this refers to usability testing using the System Usability Scale and get the final score of SUS was 81.18.

Keywords: Mobile, Menu TA/PA, I-Gracias, User Interface (UI) Pattern, User Centered Design (UCD), System Usability Scale (SUS)

In this case, the integrated academic information system Telkom University website namely I-Gracias, has a fairly serious problem with the appearance of its website page when accessed via a smartphone device because they have a bad layout even though they are already using responsive web design. Based on the results of interviews and observations, many students complained about the layout of the TA/PA menu, when accessed via a smartphone, they often experienced several problems, such as often some content on the website was not fully displayed, to the layout of the buttons and also some Important elements that existed in the desktop version are now invisible in the mobile version which makes users feel confused. This is evident after the initial usability test to 8 students from various majors using the System Usability Scale (SUS), the score obtained is 41.25 which is a bad score and received a bad response from Telkom University students.

C. Purpose

To overcome this problem, here the researcher plans to use a User Interface Design (UID) pattern approach to deal with this problem, design pattern that describes a design problem that repeats itself and serves to provide a concrete solution [4]. In general, the UID pattern consists of several general format patterns consisting of a summary of the problem, solutions, examples, and usage [5]. To find out the habits and needs of users, a user-focused development method is needed so that the UCD method is chosen. The reason researchers use UCD is because to find out a product from the user's point of view, user needs, user habits, and user experience in using a product [6]. Then the results from the previous UID pattern will help in the process of making design solutions at the UCD stage which will be used as an initial guide when designing an application and also has the aim of making it easier for developers when they want to develop an I-Gracias mobile website in the context of a user interface regarding user interaction.[4]. The limitation of the problem in this research is to focus on making the user interface display menu TA/PA from the student side.

I. INTRODUCTION

A. Background

At this time the growth of technology has increased rapidly to encourage the development of mobile technology, especially on mobile phones, because mobile phones today can balance the ability of computers in carrying out work tasks so that the naming of mobile phones can also be called smartphones. Following the development of the internet and also today's technology, cellphones have become the most frequently used gadgets [1]. Then a study said that Indonesia was one of the countries that accessed the internet the most and was ranked first in the ASEAN region and also ranked 3rd for the Asia Pacific region and it is predicted that around 67% of connections are accessed via mobile devices. [2].

Even though there are more and more smartphone users in Indonesia, sometimes there are cases where Indonesian people still prefer to use a computer in completing an activity, not because of inadequate cellphone capabilities but based on research, mobile devices, especially smartphones, often experience several problems that reduce the quality of user comfort, there are 4 categories of problem identification felt by users with the main problems which is display, interaction, experience, and others [3].

B. Problem Statement

II. LITERATURE REVIEW

A. User Interface Design Pattern

User Interface Design (UID) pattern is a design pattern that can describe a design problem that occurs repeatedly, the function of this UID pattern can also provide a concrete solution according to user needs. [4]. The UID pattern focuses on the solutions offered with the aim of increasing the

usability of a system that will be used and can be measured at the level of usage indicators. The UID pattern will always use ergonomic principles, then the rationale must be able to explain how the ergonomic principles that will be used can lead to an increase in an indicator of use [7]. Design patterns can be used repeatedly to identify user needs during the design process, so that a general pattern format is needed that can assist the process of evaluating the design pattern consisting of [5]:

1. **Problem Summary:** What user problem did you solve? Stay focused and speak like a user story in just one sentence.
2. **Solution:** How did other people solve this problem? Some things to note include user navigation (including shortcuts), getting user input, handling data and integration with other services or applications, and displaying information and content (including defaults).
3. **Example:** Great, can you show it to me? Sometimes a screenshot or mockup is enough; other times, additional user flows and/or records are required to clearly communicate the pattern.
4. **Usage:** When is this pattern used and not used? Some things to consider include product architecture, interface layout, tools, programming language, absence or presence of other design patterns, user types, and key use cases.

B. User Centered Design

User-Centered Design (UCD) is a method used for interactive system development that aims to create a software or system. User-Centered Design (UCD) is the user interface design stage that focuses on the usability, user requirements, environment, tasks, and workflows in the design [6]. There are several principles that must be applied in designing user interfaces using UCD which consist of user familiarity, consistency, minimal surprise, recoverability, and user guidance [8]. Then there are 4 stages of activity can be seen at figure 1 that will be carried out as follows [9]:

1. Specify the context of user. Understand the user, the user environment, and the tasks of the users who will use the application.
2. Specify the user and organizational requirements. Identify each user's need for the application to be used.
3. Produce design solutions. Design drafting as a solution embodiment for the application being designed.
4. Evaluate design. Evaluating from the design that has been completed through the stages that have been carried out previously.

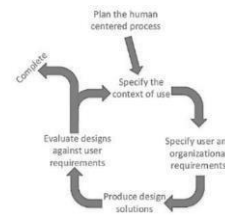


Figure 1. Stages of the User Centered Design process [9]

III. METHOD OF RESEARCH

In the process of modeling the user experience of the I-Gracias website to produce a user interface design (UID) pattern, several steps are needed to be carried out to achieve the targeted goals using the use centered design method in the user research process. The following are the steps that will be carried out in this final project which can be seen in figure 2.

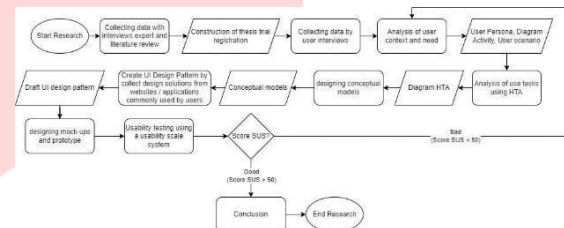


Figure 2. Modeling Flow

At the initial stage here, the researcher collects the construction of the thesis trial registration stage starting from proposal collection to revision, after successfully collecting the thesis trial registration construction the next step is to collect data on prospective users consisting of 8 Telkom University students who are or have taken final project courses. After that, start analyzing the context and user needs. After that make a conceptual model. For each component to be made, the researcher makes a design pattern based on the website or application commonly used by Telkom University students, after starting the mock-up process followed by making a prototype, after that start usability testing using the usability scale system, if the score If the final score is bad, it will return to the user analysis process, if the final score is good, the next step is drawing conclusions.

A. Collect construction space for thesis trial registration and define design solutions

In this stage, the researcher conducts the process of collecting the construction space for the thesis trial that applies at Telkom University first, the collection process is carried out by studying the literature in the guidebooks from various faculties on the Telkom University campus. In the process of collecting the construction space for the thesis trial registration, the researcher also conducted an expert interview with the LAAK staff to confirm the scope of the trial registration process to revision. After successfully collecting, the researcher then designs a solution to the problems that exist within the scope of the thesis trial registration construction which can be seen in table 1, for the full version can be seen in the attachment.

Scope	Construction of trial registration in literature	Reference
Proposal upload	<ol style="list-style-type: none"> Students have passed the course Proposal Writing in the previous semester without a break (for the first time taking the final project course). Students have at least graduated with credits that have been determined by each faculty. Students upload a proposal file that has been signed by the prospective supervisor to the TA/PA menu on the I-Gracias website. Students choose skill groups and types of final project work, enter data such as the vision of the study program, TA/PA title, abstract, background, problem formulation, objectives, problem boundaries, methodology into the I-Gracias website. 	[18],[19],[20],[21],[22],[23] and expert interview

Figure 3. Construction Space for Thesis Trial Registration

B. User Research Using UCD

In this stage, the researcher conducts a needs analysis process and the tasks carried out by the user with the aim of getting information by users when accessing the TA/PA menu on the I-Gracias website through a mobile device, while the other goal is to find out expectations users. Therefore, a user centered design method is needed at this stage to find out a product based on the user's point of view, from user habits, user needs, and user experience when using a product. To get it all there are several processes that will be carried out at this stage as follows:

1. Data collection

At the initial stage of the data collection process, the researcher identified the user first, the user who will be the primary user is a male and female Telkom University student who has experience using the I-Gracias website then is currently or has taken a final project course, Here the researchers managed to get student users from various majors. After identifying the user, the next step is to determine what the user needs to improve the design on the TA/PA menu on the I-Gracias website by conducting interviews. The interview itself was conducted using the semi-structured interview method, the researcher could freely add some additional question variables needed. The data that has been obtained at this interview stage can be used as a benchmark so that it will be processed into a user interface improvement process that is in accordance with user expectations. For questions and answers from 8 respondents can be seen in the attachment.

2. User Context Analysis

Then the next step is to understand the user context that is represented using a user persona. The first step is to analyze which is followed by designing a user persona based on the results of interviews that have been done previously. The purpose of making user personas is to know and understand user needs because personas are tools that represent user needs to assist the design process [10]. Personas are made for everyone according to the results of interviews that have been conducted previously, then obtained some information in the form of demographics, knowledge, behavior, tasks, needs, and goals of each user. From this information it can help to know the needs of a system that will be built to assist the process of designing the user interface to be able to meet user needs. Then from the results of each persona will be grouped into two categories, namely high level, and middle level persona. The determination of the category is divided based on insight, experience, and habits regarding the use of applications or websites that are commonly accessed by users

[11]. The following is a user persona that has been created, it can be seen in tables 1 for high user persona and for the mid user persona can see at the attachment.

Table 1. High User Persona

Objective	Persona
Demographic	<ul style="list-style-type: none"> Man and woman Department of Informatics, MBTI, and Industrial Engineering Telkom University students class 2017
Knowledge	<ul style="list-style-type: none"> Have a personal cellphone and laptop device Have a habit of connecting to the internet an average of more than 5 hours
Behavior	<ul style="list-style-type: none"> The average user accesses a supportive application/website to help with activities and work such as google drive, figma, collab, discord, etc. The main concern on the website is the title header followed by the website content (layout pattern F)
Need	<ul style="list-style-type: none"> Requires a website that is easy to open on various devices Requires a lightweight website when opened Requires a website with a clear flow Requires a website whose design does not make it difficult for users
Task	<ul style="list-style-type: none"> Open the website and then focus on writing the feature name or image of the feature logo that will be done If he/she find it difficult to use the feature, ask other experienced people Complete the task
Goal	<ul style="list-style-type: none"> Requires a lightweight website, a clear flow of website functionality, a design that makes it easy for users, and can be used on various devices easily and with a neat layout.

3. User Needs Analysis

In this stage, the researcher analyzes the results of the user persona to determine user needs, then provides a solution for a need that will become a functional and non-functional feature

on the TA/PA menu. At this stage there are several stages consisting of:

a. User Persona Analysis

At this stage, the researcher identified several user problems encountered when accessing the TA/PA menu on the mobile version, then analyzed and designed user needs based on existing problems, the designed user needs would be used as a benchmark for improving the TA/PA menu design on the mobile version of the I-Gracias website.

b. User Scenario

At this stage, the researcher analyzes the activities and processes that are usually carried out by users when interacting with the existing system. The following is an example of a user scenario proposal Submission can be seen in figure 4, for a full user scenario can be seen in the attachment.

No	Task	Subtask	Goals	Description	Details
3	Proposal Submission	Upload proposal	Can input student proposals into i-Gracias	On this page, students will enter student proposals into i-Gracias	Students enter student proposal files
		Choose a skill group	Can choose a student's TA/PA skill group	On this page, students will choose the type of student expert group	Students choose one of the skill group taken by students
		Study program vision	Can write the vision of the student study program	On this page, students will write the vision of the study program	Students write the vision of the study program
		Title TA/PA (Bahasa)	Can write student titles using Indonesian and English	On this page, students will write the title of TA/PA in Indonesian and English	Students write student titles in Indonesian and English
		Title TA/PA (English)	Can choose the type of TA/PA group that students take	On this page, students will choose the type of TA/PA taken individually as in groups	Students choose the type of TA/PA taken individually as in groups
		Abstract	Can write the contents of the proposal consisting of an abstract, background, problem formulation, objectives, problem boundaries, and methodology.	On this page, students will fill in a proposal consisting of an abstract, background, problem formulation, objectives, problem boundaries, and methodology.	Students write down the contents of the proposal consisting of abstract, background, problem formulation, objectives, problem boundaries, and methodology.
		Background	Can write the contents of the proposal consisting of an abstract, background, problem formulation, objectives, problem boundaries, and methodology.	On this page, students will fill in a proposal consisting of an abstract, background, problem formulation, objectives, problem boundaries, and methodology.	Students write down the contents of the proposal consisting of abstract, background, problem formulation, objectives, problem boundaries, and methodology.

Figure 4. User Scenario Proposal Submission

c. Diagram Activity

At this stage, the researcher makes an activity diagram that describes the trial registration process from submitting a proposal to making revisions, this diagram is made based on the results of expert interviews with LAAK Telkom University. The following is an example of an activity diagram of the process of making a thesis proposal until downloading the SK can be seen in figure 5, for the full activity diagram it can be seen in the attachment.

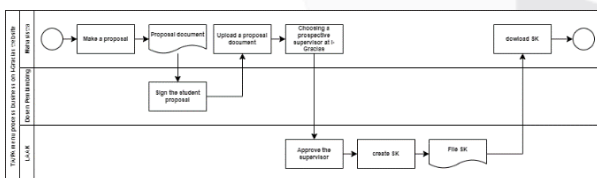


Figure 5. Diagram Activity Process of Making a Thesis Proposal

d. Task Analysis

At this stage, the researcher identified several user tasks using the Hierarchical Task Analysis (HTA) method. HTA allows the systematic breakdown of a complex operation or surgical procedure to clearly define the course of action to be performed, allows the relationship between a particular procedure and error to be more easily obtained, and allows for a more targeted evaluation of a particular skill. [12]. The following is an example of a HTA from a Proposal Submission Page, which can be seen in figure 6, for a full HTA it can be seen in the attachment.

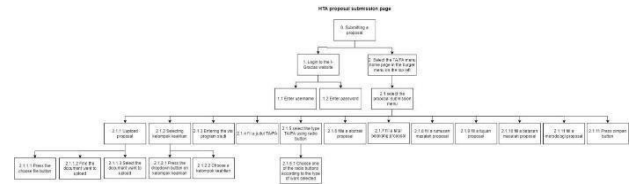


Figure 6. Hierarchical Task Analysis Proposal Submission Page

C. Creating New Design Solution by combining the UID pattern approach

In this stage the researcher will design a new design solution based on the results of the user needs analysis consisting of user personas, user scenarios, activity diagrams, and HTA in the previous stage which will be used as a reference in this process. At this stage there are several stages that will be carried out consisting of:

1. Conceptual Model

At this stage, the researcher will create a table which is a representation of the results of the user experience model analysis that has been carried out in the previous stage. The following is an example of a Conceptual Model from a Submission Proposal, which can be seen in table 4, for a full Conceptual Model it can be seen in the attachment.

No	Task	Subtask	Response	Place	Element	Description
3	Proposal Submission	Upload proposal	Displays a page that functions for users to upload proposal files and the contents of the writing in the proposal	Located at the top center of the website	Input type file	Used to upload proposal files
		Choose a skill group	Showing the expertise of the final project	Located under the input type to upload a proposal	Drop down	Used to select the skill group taken by the user
		Study program vision	Displays a text area to fill the user's study program vision	Located under the text area select the skill group	Input text field	Used to fill in the user study program vision
		Title TA/PA (Bahasa)	Displays a text area to fill in the title of the TA/PA used by the user using Indonesian	Located under the text area choose the vision of the study program	Input text field	Used to fill in the title of TA/PA using Indonesian
		Title TA/PA (English)	Displays a text area to fill in the title of the TA/PA used by the user using English	Located under the text area Title TA/PA (English)	Input text field	Used to fill in the title of TA/PA using English
		Group TA/PA	Displays a radio button to select the type of TA/PA work individually or in groups	Located under the text area Title TA/PA (English)	Radio button	Used to select the type of TA/PA work individually or in groups
		Abstract	Displays a pop up text area to fill in the abstract of the proposal	Located under the group TA/PA radio button	Pop up text area, button	Used to enter proposal abstracts using Indonesian and English
		Background	Displays a pop up text area to fill in the background of the proposal	Located under the abstract text area	Pop up text area, button	Used to enter user background
		Formulation of the problem	Displays a pop up text area to fill in the problem formulation of the proposal	Located below the background text area	Pop up text area, button	Used to enter the problem formulation
		Purpose	Displays a pop up text area to fill in the purpose of the proposal	Located below the problem formulation text area	Pop up text area, button	Used to enter Purpose
		Scope of problem	Displays a pop up text area to fill in the boundaries of Scope of problem	Located below the decrease text area	Pop up text area, button	Used to enter Scope of problem
Methodology	Displays a pop up text area to fill in the proposal methodology	Located below the problem Scope of problem text area	Pop up text area, button	Used to include research methodology		


Figure 7. Conceptual Model Proposal Submission

2. Designing a UI Design Pattern from an existing website

At this stage, the researcher will create a design solution, by making a draft UI design pattern consisting of Problem, Solution, Example, and Usage. The formation of this draft UI design pattern has a very important effect on each component that will be a reference in the process of making the interface design. So here researchers only need to use the components that have been determined. For each solution offered comes from a website / application component that is often used by previous students, so that students will find it easier to use these components because they are familiar with each of the existing component features. Here is an example of a draft UI design pattern from a pop-up text field

in table 2, for a full UI Design Pattern it can be seen in the attachment.

Table 2. Example UI Design Pattern Smart Keyboard

Smart Keyboard	
Problem	user wants to enter information quickly
Solution	Displays the keyboard format that is relevant to the data needed when the user wants to provide information in the form of letters (qwerty) or numbers. The way to activate the keyboard is by pressing the screen in the text area provided, if the user is asked to enter a word or sentence, the keyboard appears with a qwerty format, if the user is asked to enter a number, the numeric keyboard appears.
Example	Shopee
	
Usage	<ul style="list-style-type: none"> Use it when the user wants to enter information by bringing up a qwerty format keyboard that can help the user when entering a sentence Use it when the user wants to enter information by bringing up a numeric keyboard that can help the user when entering a number Do not use it when the information to be entered is easier when the information to be entered is in the form of choices, such as gender information (providing male and female choices will be able to help users be faster when entering information)

3. Mock-Up Design

At this stage, the researcher designs an interface design solution using the Figma application, which is very concerned in terms of color selection, images, icons, placement of element layouts, layouts, and several other things that will be very concerned at this stage and will combine the UI design pattern elements that have been created. The following is an example of a mock-up of the Proposal Submission Page design can be seen in figure 5, for a full mock-up it can be seen in the attachment.



Figure 8. Mockup Proposal Submission Page

4. Prototyping

After completing the mock-up design until it has a flow base on the existing user scenario, the next step is for researchers to make the mock-up display more interactive and according to the existing UI design pattern elements.

IV. RESEARCH RESULT AND DISCUSSION

After the mock-up creation process was completed, the researcher conducted usability testing for several potential users. Then the researcher observed users. After that, the researcher evaluates the prototype by asking for feedback from the user to mention the user experience after using the prototype. For designs that are still difficult to understand by users or there is a problem in the design, the researcher will test individual design patterns for each design problem encountered to redesign several design solutions, then retest again for each design solution made to the user.

A. Observation and Evaluation Data

In this stage, the researcher observed the users by testing the mobile version of the TA/PA I-Gracias menu prototype by completing several tasks. Starting from submitting proposals to revisions, for the evaluation process, the researchers used the System Usability Scale (SUS) method. SUS is the most popular usability testing method and has been around since 1986 by John Brooke, SUS is also a reliable, popular, effective, and inexpensive usability scale. [13]. This method can be used in various products, one of which is a website, this method is also very easy to use because it has a scale of 0-100. This method is also proven to be valid so that it can prove to be a valuable, strong, and reliable evaluation tool. [14].

The evaluation in this study involved 8 Telkom University students from various majors, for the selected criteria, were students who are currently or have already taken a final project course, then the user is asked to complete several step tasks that must be done which consists of 11 steps, namely being able to perform login, can upload a proposal, can choose a supervisor, can download SK, can do online guidance, can register for thesis trial, see the completeness of the session, can see the trial schedule, can

see a list of ongoing TA/PA, can view revisions, and the last one can download the user manual. After the user has done all these tasks, the researcher asks the user to fill in several questions. For how to use SUS itself here has 10 questions to measure user satisfaction, consisting of 5 positive questions and 5 negative questions [15]. Here is the question SUS can see at table 3:

Table 3. List SUS Question [15]

No	Question
1	I think that I would like to use this system.
2	I feel this feature is too complicated even though it can be made simpler.
3	I think this feature is easy to use
4	I think I need help from a technical person to be able to use this feature.
5	I find that there are various kinds of features that are well integrated into the system.
6	I think a lot of inconsistencies are found in this feature.
7	I think the majority of users will be able to learn this feature quickly.
8	I find that this feature is very impractical when used.
9	I am very sure I can use this feature.
10	I have to learn many things first before I use this feature.

For each question that has an odd number such as 1, 3, 5, 7, and 9 is a positive question then for each value the weight will be reduced by a value of 1, then for each question that has an even number such as 2, 4, 6,8, and 10 is a negative question then for each value obtained is 5 subtracted from the score obtained. For answer values ranging from 1 (strongly disagree) to 5 (strongly agree) [16]. Then the raw SUS score will be obtained, then the final SUS score is obtained from the raw SUS score divided by the number of respondents, so that the SUS score of 8 people is 81.18 and is included in the VERY GOOD category with an A-scale score can see at figure 9.

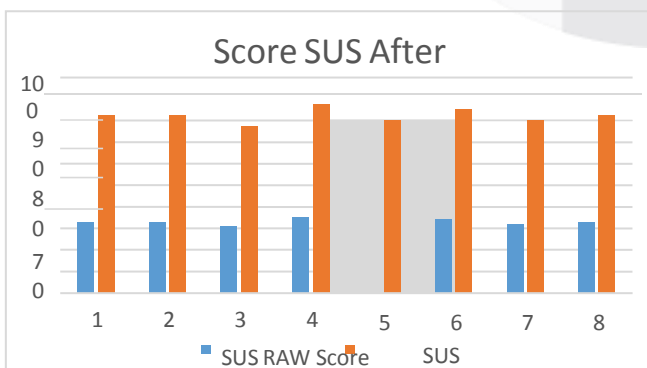


Figure 9. Score System Usability Scale from 8 Respondents

Then to make the SUS score more meaningful, here the researcher interprets the SUS score in 4 ways, namely from percentile rank, grades, adjectives, and acceptability. It can be seen in figure 10 showing the measuring scale for acceptability, adjectives, and grade scale [14]. Then it can be seen in figure 8 to give the graphic value in figure 7 and the percentile rank [17].

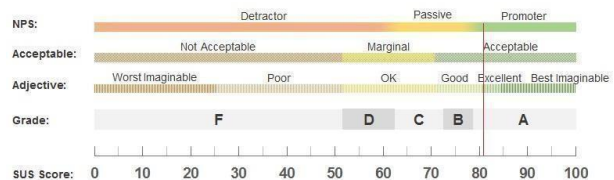


Figure 8. Percentile, grade, adjective, and acceptable to describe the SUS score [17]

1. Percentiles

SUS scores can be converted into percentile ratings, percentile ratings can tell how well the SUS scores are compared to others in the database. From the results of this study, the final value of the SUS score was 81.18, which means the value is above the average and has a percentile range of 90-95 based on figure 8.

2. Grade

The grade scale is one of the important aspects in determining the quality level of a website, a value with a range of A indicates superior performance while a value with a range of F indicates a failed performance. From the results of this study obtained a grade with a value of A.

3. Adjective

Adjective is an aspect of determining the performance rating on the website, from the results of this study it has a SUS score of 81.18 so that the adjective rating obtained is EXCELLENT because the score results are in the range above 80.8.

4. Acceptability

Another variation to describe the value of the SUS score in words is to think about whether it is acceptable or unacceptable, because in this study the final SUS score was 81.18 so it could be categorized as ACCEPTABLE.

V. CONCLUSION

Based on the results of the User Centered Design method which was adapted into User Interface Design Pattern modeling research to redesign the TA/PA menu on the mobile version of the I-Gracias website, it can be concluded that:

1. A new user interface has been obtained for the TA/PA menu on the mobile version of the I-Gracias website which can provide solutions to student needs when they want to use the TA/PA menu starting from the proposal submission process to revision.
2. At the evaluation stage, the new user interface using the SUS method gave positive results by showing an increase in the previous SUS score of 41.25 on the old I-Gracias mobile website. After the user centered design (UCD) method was applied, the SUS score increased to

81.18 then the percentile rank value was 90-95, the grade value was A, the adjective rating was EXCELLENT, and the acceptability level was ACCEPTABLE. This can show a very good response and in accordance with the needs of Telkom University students.

REFERENSI

- [1] J. Poushter, "Smartphone Ownership and Internet Usage Continues to Climb in Emerging Economies," p. 45.
- [2] L. A. Abdillah, "Analisis Aplikasi Mobile Transportasi Online Menggunakan User Experience Questionnaire pada Era Milenial dan Z," *J. Sistem Info. Bisnis*, vol. 9, no. 2, p. 204, Nov. 2019, doi: 10.21456/vol9iss2pp204-211.
- [3] Q. Chen, C. Chen, S. Hassan, Z. Xing, X. Xia, and A. E. Hassan, "How Should I Improve the UI of My App?: A Study of User Reviews of Popular Apps in the Google Play," *ACM Trans. Softw. Eng. Methodol.*, vol. 30, no. 3, pp. 1–38, May 2021, doi: 10.1145/3447808.
- [4] S. Suleri, N. Kipi, L. C. Tran, and M. Jarke, "UI Design Pattern-driven Rapid Prototyping for Agile Development of Mobile Applications," in *Proceedings of the 21st International Conference on Human-Computer Interaction with Mobile Devices and Services*, Taipei Taiwan, Oct. 2019, pp. 1–6. doi: 10.1145/3338286.3344399.
- [5] W. Zuberi, *Mobile UI Design Patterns "A Deeper Look At The Hottest Apps Today."* UXPin, 2014.
- [6] C. Abras, D. Maloney-Krichmar, and J. Preece, "1. Introduction and History," p. 15, 2004.
- [7] M. van Welie and H. Tr, "Interaction Patterns in User Interfaces," p. 26.
- [8] Y. Mukti, "Rancang Bangun Website Sekolah Dengan Metode User Centered Design (UCD)," *betrik*, vol. 9, no. 02, pp. 84–95, Jul. 2018, doi: 10.36050/betrik.v9i02.34.
- [9] S. Supardianto and A. B. Tampubolon, "Penerapan UCD (User Centered Design) Pada Perancangan Sistem Informasi Manajemen Aset TI Berbasis Web di Bid TIK Kepolisian Daerah Kepulauan Riau," *JAIC Polibatam*, vol. 4, no. 1, pp. 74–83, Jun. 2020, doi: 10.30871/jaic.v4i1.2108.
- [10] K. Y. Palilingan, A. J. Santoso, and F. L. S. Rahayu, "Perancangan Aplikasi Pencarian Tempat Wisata Berbasis Lokasi Menggunakan Metode User Centered Design (UCD)," p. 7.
- [11] A. Cooper, R. Reimann, D. Cronin, and A. Cooper, *About face 3: the essentials of interaction design*, [3rd ed.], Completely rev. & Updated. Indianapolis, IN: Wiley Pub, 2007.
- [12] "A Guide To Task Analysis," p. 309.
- [13] A. Saputra, "Penerapan Usability pada Aplikasi PENTAS Dengan Menggunakan Metode System Usability Scale (SUS)," *jtim*, vol. 1, no. 3, pp. 206–212, Nov. 2019, doi: 10.35746/jtim.v1i3.50.
- [14] S. Aisyah, E. Saputra, N. E. Rozanda, and T. K. Ahsyar, "Evaluasi Usability Website Dinas Pendidikan Provinsi Riau Menggunakan Metode System Usability Scale," vol. 7, no. 2, p. 8, 2021.
- [15] R. S. Pradini, R. Kriswibowo, and F. Ramdani, "Usability Evaluation on the SIPR Website Uses the System Usability Scale and Net Promoter Score," in *2019 International Conference on Sustainable Information Engineering and Technology (SIET)*, Lombok, Indonesia, Sep. 2019, pp. 280–284. doi: 10.1109/SIET48054.2019.8986098.
- [16] G. W. Sasmito, L. O. M. Zulfiqar, and M. Nishom, "Usability Testing based on System Usability Scale and Net Promoter Score," in *2019 International Seminar on Research of Information Technology and Intelligent Systems (ISRITI)*, Yogyakarta, Indonesia, Dec. 2019, pp. 540–545. doi: 10.1109/ISRITI48646.2019.9034666.
- [17] J. R. Lewis and J. Sauro, "Item Benchmarks for the System," vol. 13, no. 3, p. 11, 2018.
- [18] R. Wahyuningtyas, "Tata cara pelaksanaan tugas akhir mahasiswa program sarjana dan pascasarjana di lingkungan fakultas ekonomi dan bisnis Universitas Telkom," Dekan fakultas ekonomi dan bisnis (FEB) Universitas Telkom, 2020.
- [19] S. A. Faraby, : "Panduan Tugas Akhir (CCH4D4) Program Studi Sarjana: 3: Desember 2017: Ketua Program Studi S1 Teknik Informatika," p. 46.
- [20] Dekan fakultas Industri Kreatif, "Buku Panduan Tugas Akhir/Skripsi Fakultas Industri Kreatif Universitas Telkom," Dekan fakultas Industri Kreatif Universitas Telkom, 2020.
- [21] J. Sembiring, "Pedoman Penulisan Tugas Akhir Fakultas Komunikasi dan Bisnis," Dekan fakultas komunikasi dan bisnis, 2016.
- [22] T. Fabrianti Kusumasari, "Pedoman Penulisan Tugas Akhir Fakultas Rekayasa Industri," p. 36, 2020.
- [23] E. Sri Sugesti, "Buku Panduan Pelaksanaan Tugas Akhir Fakultas Elektro," Dekan fakultas elektro Universitas Telkom, 2017.