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USABILITY TESTING ON THE MOBILE GRAS (GREEN TRASH SYSTEM) APPLICATION USING THE USABILITY SCALE SYSTEM METHOD

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Abstract

This study focuses on the GRAS (Green Trash System) mobile application, developed under the KEDAIREKA program to enhance waste management efficiency. The application is an integral part of the GRAS smart waste system, designed to facilitate real-time monitoring and reporting of waste capacity issues. The primary objective is to streamline waste sorting processes and educate users, particularly students, about sustainable waste management practices. The system features innovative sensor technology that provides audio feedback for correctly sorted waste, thus reinforcing correct behaviors. To assess the application's effectiveness, we conducted a usability test using the System Usability Scale (SUS) method. Data were collected through questionnaires to evaluate the application's ease of use, efficiency, and user satisfaction. The results indicated a high level of usability, with most users experiencing seamless interaction with the application, affirming its potential as a tool for effective waste management education and practice.

Keywords : System Usabilty Scale, Mobile Application Development, User Satisfaction

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INTRODUCTION

Waste is a global problem that urges all human beings to compete to solve this problem. Starting from food waste to plastic waste which continues to accumulate and increase until it becomes a serious problem and has a negative impact on the environment, human health and the sustainability of life in the world. One of the biggest sources of waste comes from human life processes. Waste that comes from human life has a big impact on aspects of life and the environmental ecosystem. The process of managing waste from human life is not easy. The waste management process is quite complex. Waste management is an effort to regulate or manage waste from the process of containerization, collection, transfer, transportation, processing, to final disposal[1].

Increasing urbanization, excessive consumption and technological developments have also played a role in increasing the amount of waste produced every day. This waste can be plastic, paper, metal, electronics, food, and much more. Managing waste properly has become one of the biggest challenges for the government, society and the business world. The importance of the waste problem cannot be ignored. The negative impacts of waste on the environment include air, land and water pollution, as well as climate change. Garbage can also damage biodiversity and threaten natural ecosystems. Apart from that, this problem also has serious health impacts for humans, because it can cause disease and poisoning. Waste will have economic value if the amount is sufficient to be traded or further processed into goods of economic value. Therefore, it is important for all levels of society to understand how important it is to manage waste wisely.

Good waste management must be taught as early as possible. Efforts to raise awareness about environmental sustainability must be taught from an early age. This can be done starting by doing small things such as not littering and sorting waste properly and correctly. Apart from that, educating students about types of waste is a good step to increase

awareness about the importance of waste management. Students must be socialized to abandon the old method of just throwing away trash, but also provide education and familiarize students with sorting, selecting and categorizing waste as well as developing a waste bank so that it has economic value. If this is done, the practice of processing and utilizing waste becomes a real step in managing waste. The cleanliness of the environment is one thing that is very important to be maintained. Waste is a problem that is often encountered in everyday life, so that waste conditions become something that requires special attention, especially in the trash. The condition of the trash bin must always be ready to be filled and when it is full, it must be immediately followed[2]

The KEDAIREKA project GRAS program aims to make this happen. This project was built to educate students about waste sorting. This project uses a smart trash can which is an IoT device. This smart trash can is connected to a mobile application to help monitor the waste capacity of each type of existing waste storage. Therefore, this can help cleaning officers in the process of monitoring and managing waste. The smart trash bin designed works by using several types of sensors in the sorter. If students put the wrong waste in the sorter, this trash can will provide information to confirm that the waste was put in the wrong place. This information will be issued in the form of sound.

Apart from the smart trash can, the most important part in the process of working on this project is the design of the GRAS application. The GRAS application was built using the Flutter framework. The Flutter framework is a framework developed by Google for the application development process. This framework uses the Dart programming language. Developing applications using Flutter makes the application creation process faster. Apart from that, the applications developed can run on several operating systems such as Linux, Windows, Android and also iOS. Flutter is an open-source SDK to create high-performance mobile applications supported by the ARM native code that allows developers to target two platforms at once, i.e. Android and IOS For that reason, the Flutter framework is used in the GRAS application development process[3].

In addition to the design of these systems effectiveness, efficiency and satisfaction are considered important factors in the application design. The problem that is emerging in the computer science community is that the usability of applications is overlooked by many developers which causes problems[4]. Effectiveness is a term that relates to the accuracy and completeness with which users accomplish defined goals. While efficiency refers to the resources used in relation to the accuracy and completeness with which users accomplish goals. Satisfaction, on the other hand, relates to the ease and acceptability of use[5]. The key to the success of digital applications is the level of usability[6]. Usability testing needs to be done on the application prototype so that when the development is at an advanced stage, there are no fatal errors[7]. Usability testing is a technique to evaluate a product by testing it on future users, which provides direct input on how they use the system. It aims to check whether the product meets the assumed goals and requirements. Examples of products that most often benefit from usability testing are websites, web applications, computer interfaces, and physical products

In the application development process, usability testing is done to determine how easy the users can interact with the application. To test this, a usability testing process needs to be carried out. In the usability testing process for GRAS application development, it is carried out using the system usability scale method. System Usability Scale (SUS) is a method for testing the usability of an application using ten scales that provide a global user view of its usefulness. The aim of usability testing with the SUS approach is to assess the usability of an application with a technique that is easy and fast but reliable. Users' experiences with mobile apps vary depending on the type of device used, users often report difficulty using mobile apps. It is vital that the end user is considered throughout app development (particularly where the app is to be used in clinical cohorts) and that testing for both technical and clinical effectiveness is completed so that functionality can be optimized[8]

System Usability Scale (SUS) is a user test method that provides a reliable "quick and dirty" measuring tool. This method was introduced by John Brooke in 1986 [9], which can be used to carry out various types of products including website and application tools. The reason researchers use the System Usability Scale method in testing GRAS

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applications is because the SUS method has been tested and reliable for approximately 30 years and **still proves that this method is very good for use in evaluating systems** such as websites and applications. For that reason, researchers used this method.

METHOD

The subject studied was the GRAS (Green Trash System) application. This application is specifically designed to monitor the storage capacity of smart trash bins used in the GRAS project. Apart from that, this application is used as an information tool to convey obstacles that occur in the process of using the GRAS smart trash bin. This application really helps this process. The stages carried out in this research can be described in the flowchart in Figure 1. There are several steps is done when do this research .

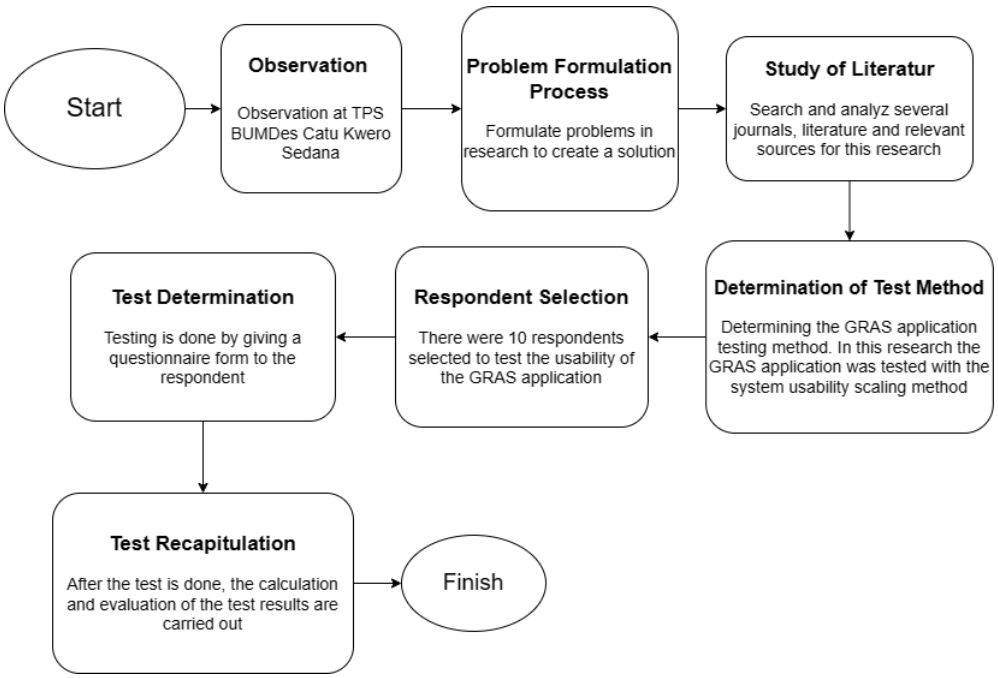

Figure 1. Stages in Research

In the usability testing process of application, the application is tested using the system usability scale method. This test was carried out to determine the usability performance of the GRAS application. Usability is the level of ability of an application that can be used by users easily and the purpose of use is achieved. In essence, an application is said to have good usability if the application is easy to use and its function or purpose of use is as desired [10]. There are five elements contained in the usability testing process. These elements include:

1. Learnability, the application developed must be easy for users to learn so that users can easily complete their work.
2. Efficiency, the application developed should be efficient so that it can increase user productivity.
3. Memorability, the system or application that you want to build should be easy to remember, this is so that users who have used it do not need to learn from the beginning.
4. Errors, the system must have few errors so that users will experience few errors in using the application or system.
5. Satisfaction, the system developed must be comfortable to use so that it can satisfy users when using the system.

The sample is part of the population subject to be studied. This research used a purposive sampling technique. The purposive sampling technique was carried out by taking several subjects without any specific aims or objectives. The purposive sampling technique is

good to use when there are limited time, energy and funds.

According to Nugroho (2022), measuring usability in a system, whether in the form of a website or application, using the system usability scale method, has several advantages, namely as follows[11]:

1. Test results using the system usability scale method using a scale of 0 – 100, this can simplify the process of using this method in the usability scale process
2. The calculation and calculation process is not complicated
3. Can be done without additional costs or can be done for free
4. Good for use using small samples but proven to be valid and consistent

In table 1, you can see 10 statements used in the system usability scale process if you refer to John Brooke's reference [9]. Each statement in the usability scale system instrument has a value weight with a value scale of 1 – 5. Each respondent is required to fill in a value for each statement in the table. Each respondent fills in the value subjectively with a description of the value, which is as follows:

- Strongly Disagree = 1
- Disagree = 2
- Doubt = 3
- Agree = 4
- Strongly Agree = 5

The midpoint scale or what is called neutral is used for assessments that do not find the correct assessment. Each questionnaire question has a score on a scale ranging from 1 to 5. Where, the question items are classified into 2, namely for items 1,3,5,7 and 9 or odd numbered items, the score contribution is the position scale minus 1. Details of the number calculation This can be seen in equation 1.

$$\text{SUS score (odd number)} = \sum Px-1 \quad (1)$$

For items 2,4,6,8 and 10 or even numbered items the contribution is 5 minus the scale position. Details of the calculation of even numbered items can be seen in the details below.

$$\text{SUS score (even number)} = \sum 5 - Pn \quad (2)$$

Multiply the number of values by 2.5 to get the overall system usability scale value. The detail can be see in equation 3.

$$\text{SUS score} = (\text{SUS (odd number)} + \text{SUS (even number)}) * 2.5 \quad (3)$$

The final result ranges from 0 to 100. Meanwhile, the overall score is obtained from the average score from the system usability scale score calculation of the overall individual scores in equation 3 [11].

Table 1. Instruments on the System Usability Scale

No	Statement
1.	I think that I would like to use this system frequently
2.	I found the system unnecessarily complex
3.	I thought the system is 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 this 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

The following is an example of a calculation to get a system usability scale score using data from a respondent. In the table 2 we use the answer of a respondent as an example to perform calculations to get the SUS score.

After getting this data, then reduce the score of the odd numbered statements by 1. Meanwhile, subtract 5 from the value of each even numbered statement. After carrying out these calculations, the following values are obtained

.

Table 2. Data from one respondent

Respondent	Value of Statement									
	1	2	3	4	5	6	7	8	9	`10
1	4	1	3	2	4	2	5	1	4	1

Table 3. Data from a respondent after calculations have been carried out

Respondent	Value of Statement (After Calculation)									
	1	2	3	4	5	6	7	8	9	`10

1	3	4	2	3	3	3	4	4	3	4

To get a system usability scale score from a respondent, this can be done by adding up all the values from the statements that have been calculated. After all the values are added up, the value is multiplied by 2.5. The following are the system usability scale scores from these respondents. The detail can be seen in equation 4.

SUS = (3 + 4 + 2 + 3 + 3 + 3 + 4 + 4 + 3 + 4) * 2.5
= 33 * 2.5
= 82.5 (4)

In addition to evaluating the GRAS application mobile with the involvement of the evaluator, a usersatisfaction questionnaire was also conducted after using the application. It is carried by using System Usabilty Scale (SUS) questionnaire. A questionnaire is a technique that measures the level of user satisfaction in a quantitative result. It is very easy to use. System Usabilty Scale (SUS) questionnaire is very popular[12], [13]. The System Usabilty Scale has been widely used to determine the usefulness of the application on mobile phones and tablets using the iOS and Android platforms[14]. The results of the SUS questionnaire is very easy to understand[15] and also commonly use by the people.

RESULTS AND DISCUSSION

GRAS is an application that is connected to the GRAS smart trash can. Project GRAS is one of the projects in the KEDAIREKA program. The GRAS project aims to be a socialization media for students in Pecatu Village, Badung Regency, Bali Province. This application is used by cleaning officers who handle rubbish in the Pecatu area.

There are several advantages of this application, namely flexibility in accessing GRAS rotary trash bin storage data, good performance so that it is comfortable for users to use, functionally this application can make it easier for cleaning staff in the process of monitoring trash cans used in the GRAS project. This application was built using the Flutter framework written in the Dart programming language. The features in this application include:

1. Dashboard or details, this section of the page contains details of the capacity of each container in the GRAS waste bin
2. Log page, this part of the page contains the history of activities that occurred in the trash. Therefore, officers can see the history of the collection of trash cans in detail starting because this section contains the time and date of historical details of the collection.
3. Location page, the details page contains details and a map of the location of the GRAS smart trash can selected by the user

The GRAS app is specifically designed to be able to connect to all GRAS smart waste bins. The GRAS trash can is an IoT device that can send storage capacity data via an HTTP protocol. The data is serve using API. GRAS application uses the API model as a content provider and very suitable for applications that are running on mobile devices, such as smartphones and tablets. Data is sent to the client using JSON format to make it easier to understand by human and friendly to the CPU [16]. Next, the data is displayed on a mobile application. This mobile application is designed to make it easier for cleaning staff to carry out monitoring. To use this application, an officer must enter his email and password to log in. The login page of the GRAS application is functioning properly. The login page on the GRAS application can be seen as in Figure 2.

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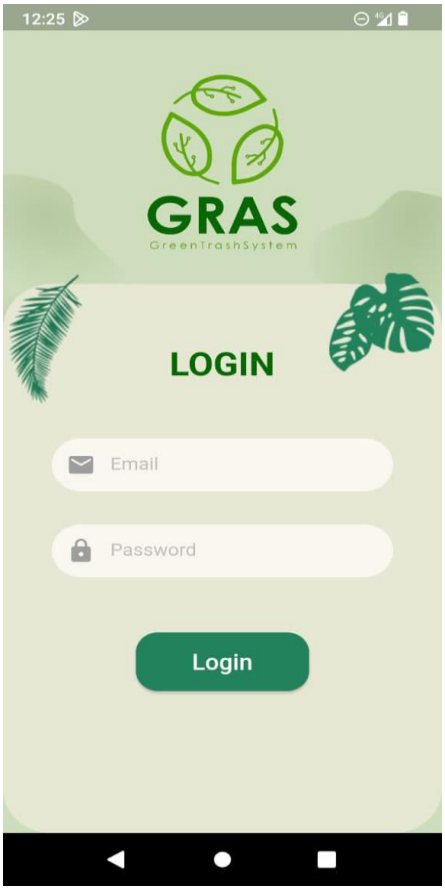

Figure 2. GRAS Application Login View

After logging in, the user can see the list of GRAS smart bins in the application. On this page, smart trash can be selected according to the location where the trash are placed. The storage capacity of each smart trash can be seen through the application by pressing one of the trash in the list. The display of the collection of GRAS smart trash can be seen in Figure 3. The list of trash will appear according to the place of assignment of each employee. In the user display section, each list of trash contains a green or red circle mark, each item that has a green circle mark, indicating that the trash is still active. However, if the bin item has a red circle mark, it means that the bin is no longer active. Each officer can only see the details of each GRAS smart trash can if the trash is still active. If the bin item has a red circle mark, then the bin is no longer active and employees cannot see details of the storage capacity of the inactive bin.

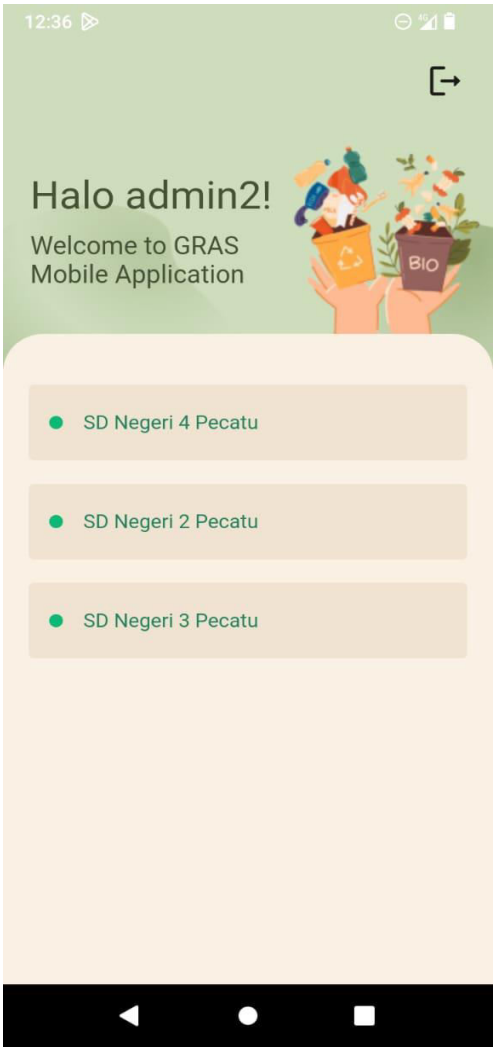

Figure 3. GRAS Application Dashboard View

After selecting the trash, users can view the capacity of each trash. Each trash consists of three types of storage, namely plastic bottles, organic and inorganic waste. The display of the smart trash details page of GRAS can be seen in Figure 4. On the details page, it can be seen that each type of storage contains a capacity indicator which is used to see how much the GRAS trash storage has been filled. This indicator will certainly make it easier for the janitors to carry out their duties.

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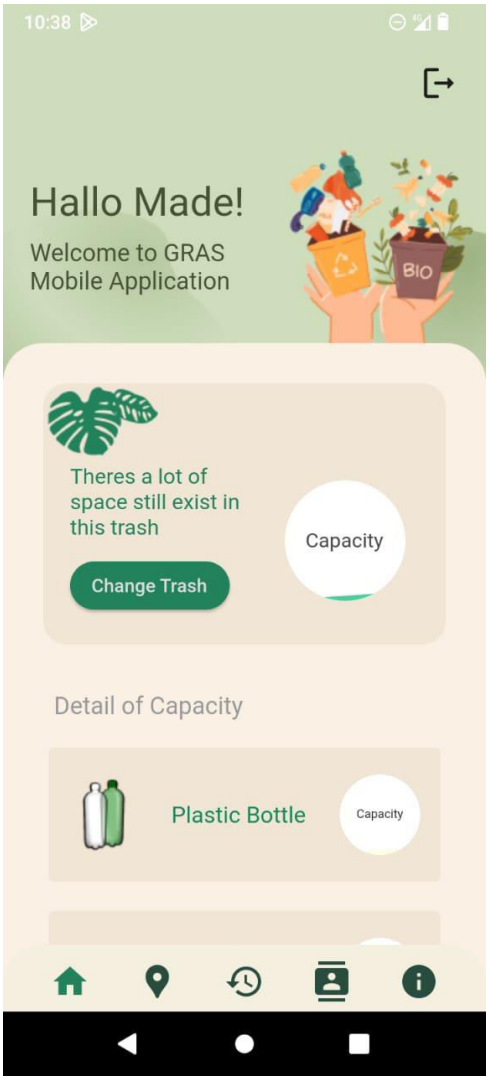

Figure 4. GRAS Trash Storage Detail Page

Usability testing of the GRAS (Green Trash System) application was carried out using the system usability scale method. This study involved 30 respondents to test the usability of the GRAS application. The 30 respondents are people who have had contact with the GRAS smart trash can. The respondents who were given the questionnaire were employees in charge of transporting waste at BUMDES Catu Kwero Sedana. Each respondent who is given a questionnaire in the SUS testing process of the GRAS application will be given an instruction to follow directions in using the GRAS application so that later each respondent can fill out a questionnaire which is used as an evaluation result in SUS. The flow of SUS testing of the GRAS application can be seen in the Figure 5.

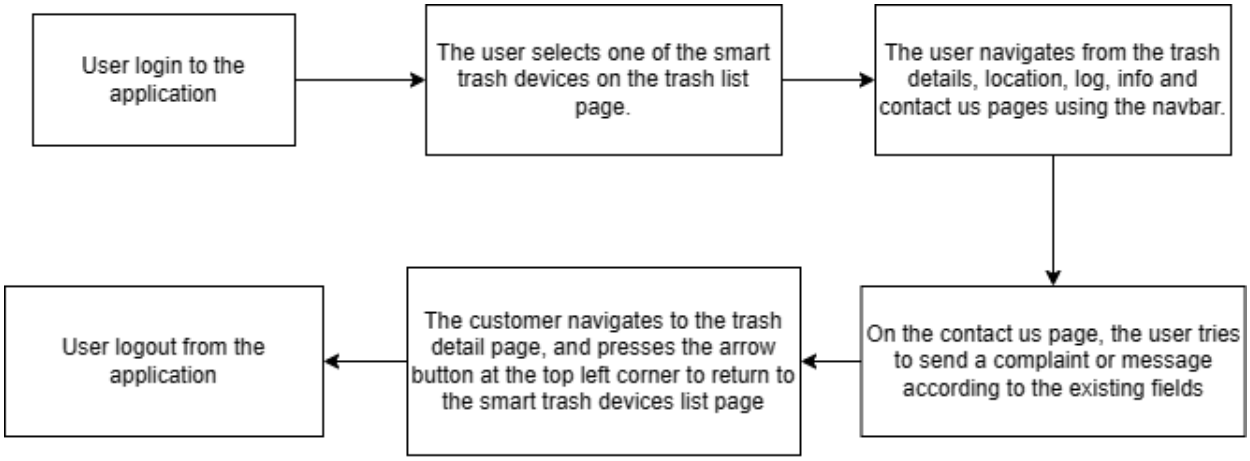

Figure 5. Instruction Direction to Test the Usabilty of GRAS Appplication

The data processing process to obtain the system usability scale value is carried out as follows::

1. Each answer in each statement filled in by respondents, converted into a value on a scale of 1 to 5
2. The next step is to calculate the system usability scale

Details of the results of the calculation of the system usability scale score can be seen in equation 5. The results of the calculations below will be used as a reference for analyzing the value of the system usability scale score in the GRAS application.

$$\bar{x} = \frac{\sum x}{n} \quad (5)$$

Description :

$\bar{x}$ = SUS average score
Σx = Total of SUS Score

The calculation result with using system usability scale of GRAS application can be seen in table 4.

Tabel 4. Hasil Perhitungan System Usability Scale

Responden	Skor SUS	Responden	Skor SUS	Responden	Skor SUS
1	82.5	11	85	21	82.5
2	87.5	12	75	22	77.5
3	77.5	13	90	23	85
4	85	14	82.5	24	80
5	82.5	15	87.5	25	87.5
6	77.5	16	77.5	26	85
7	90	17	82.5	27	80
8	77.5	18	85	28	82.5
9	85	19	85	29	80
10	80	20	82.5	30	82.5
Jumlah Total : 2480					
Jumlah Rata - Rata SUS : 82.66667					

From the calculation results using the system usability scale method, it gives a score of 82.66667. From the system usability scale score, it is then converted into letter grades form. If the system usability scale value is converted into letter grades, the GRAS application belongs to class B. Letter grades in the system usability scale method consist of letter grades A, B, C, D, E, F. Class A is the best class while class F is the worst class. To determine it can use the reference in Figure 6.

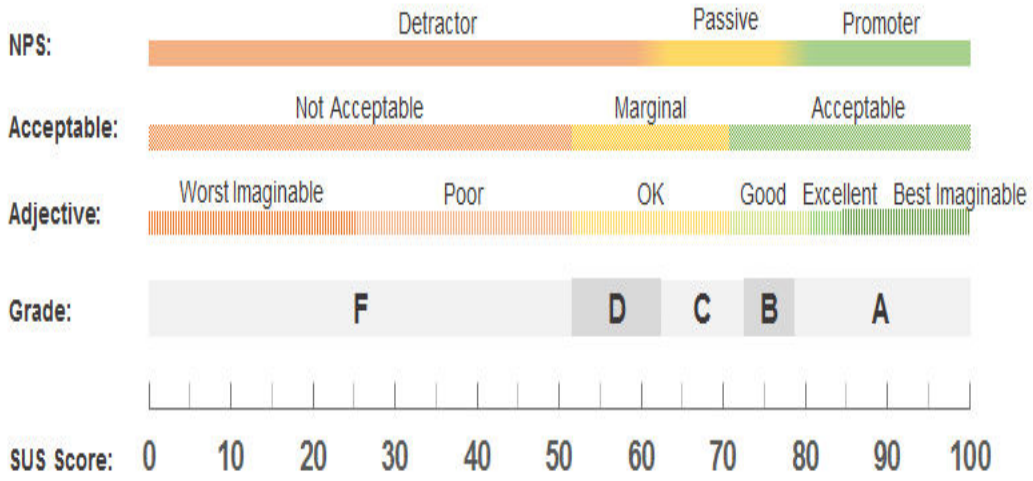

Figure 6. Scale for Determining NPS, Acceptability Range, and Letter Grade Scale for Determining NPS, Acceptability Range, Adjective Rating, and Letter Grade

From the score of the GRAS application usability scale system, it is then converted into adjective ratings and acceptability ranges. Adjective ratings are used to show the level of usability to make it easier to interpret the system usability scale score. Acceptability ranges show how much an application or website can be accepted by users. Based on adjective ratings, the GRAS application is included in the ***Good*** category. The GRAS application gets a SUS score of 82.66667, based on the acceptability ranges of GRAS application in the ***Acceptable*** category. Acceptable means that the GRAS application can be well received by its users. The last value that can be seen using the system usabilry scale score is Net Promote Score (NPS) value. The Net Promote Score (NPS) value of the GRAS application shows if the use of the GRAS application is still passive to promoter. NPS is created by Reichheld[17] with the aim to measure user satisfaction about the specific product. NPS also one of the simplest methods to categorized customers according to their answers[13]. Previous study by Pradini et al[14] adopted NPS in order to measure the user satisfaction towards SIPR web-based system. The author claimed that, the SIPR get NPS result is 80 %, which means the user is very satisfied with the system.

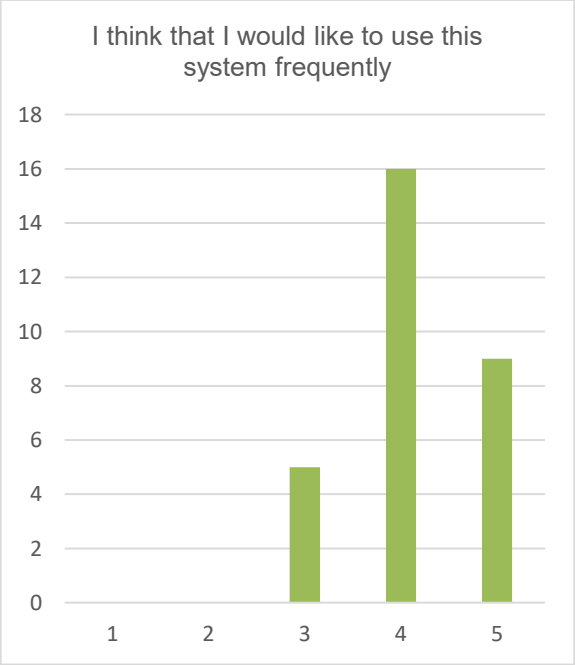

Figure 7: Graph of Positive Statements

The graph in Figure 6 is an example of a graph that illustrates a positive statement. A positive statement means that the value will be higher if the respondent gives an agreeing value. In the graph in Figure 7, it can be seen that 83% of respondents think they will use the GRAS application. This value is fairly good but can continue to be improved.

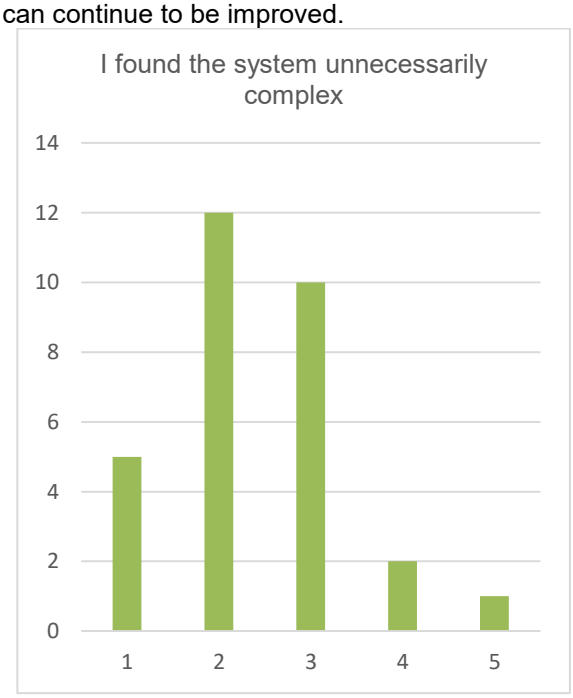

Figure 8: Graph of Negative Statements

On the other hand, the graph in Figure 8 is an example of a negative statement. A negative statement means that the scale will have a higher value if the respondent gives a disagreeing value. Based on the graph above, it can be seen that 57% of respondents think the GRAS application is not complicated to use. As many as 43% of respondents hesitated to agree that the GRAS application was complicated to use. If you look at these figures, the GRAS display needs to be improved to make it more user-friendly. This can be done by adding video tutorials and better use of colors between buttons, cards and other components in the application.

CONCLUSION

Based on the result of system usability testing evaluation of the GRAS application using the system usability scale method, the GRAS application gets a good system usability scale score. The GRAS application gets a system usability scale score of 82.66667. The GRAS application gets letter grades ***B***. In addition, referring to the value of adjective ratings into the ***Good*** class. This application has also been well received by its users when viewed from the acceptability ranges category. Based on this data, the GRAS application already has good functionality. However, there are several aspects that can still be improved, such as

application performance and responsiveness that can be improved so that the value or score above can increase.

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