

Application of Design Thinking Method in Developing Website-Based Balanced Fertilizer Usage Information System

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ABSTRACT

At this time the use of fertilizers is very important to increase plant productivity, but the use of fertilizers that are not in accordance with the needs of plants can affect the environment and the plants themselves due to improper use of fertilizers. After a survey conducted to farmers in North Aceh Regency, 90 percent of the 30 respondents surveyed did not know how to use balanced fertilizers. From these problems the author wants to develop website-based balanced fertilization information media that can be accessed anywhere via cellphone or laptop, in the development of information media using the Design Thinking method to design information media and using the System Usability Scale (SUS) and User Experience Questionnaire (UEQ) methods to test the website. The results of this study are the creation of website-based balanced fertilization information media that can answer the problems that occur and can help farmers get information, and the results of SUS testing get a performance value of 86.83 (Excellent), while UEQ testing gets a benchmark value above the average on 6 aspects with an Excellent value.

Keywords: *Balanced Fertilization, Design Thinking, UEQ, SUS.*

1. INTRODUCTION

The development of information technology has never been separated from the daily aspects of people's lives, almost all levels of society utilize the internet for personal life such as information about health, education, business, entertainment, and agriculture. The Agricultural Extension and Human Resources Development Agency (BPPSDMP) of the Ministry of Agriculture noted that young farmers in Indonesia aged 20-39 years only amounted to 2.7 million people or around 8 percent of the total 33.4 million farmers, the remaining more than 90 percent including colonial farmers or old farmers [1].

Based on the results of a survey conducted on farmers in North Aceh District, 90 percent of the 30 respondents surveyed did not know how to use balanced fertilization, and 96.7 percent of farmers used inorganic fertilizers, while only 3.3 percent used organic fertilizers.

Due to the lack of understanding of farmers about the correct balanced fertilization, farmers need a website-based information media that can be accessed anywhere through smartphones or similar devices. The reason for using the website as an information medium is based on a survey conducted that 86.7 percent of farmers search for information via the internet and the rest search for information through newspapers, fellow farmers, etc.

2. LITERATURE REVIEW

2.1. Balanced Fertilization

Balittanah (2013) explains that balanced fertilization is the application of fertilizers into the soil to achieve a balanced and optimum status of all essential nutrients in the soil to increase the production and quality of agricultural products, fertilizer efficiency, soil fertility and avoid environmental pollution.

2.2. Integrated Fertilization

Integrated fertilization is the incorporation of organic and inorganic nutrient inputs simultaneously in various crops. The goal of integrated fertilization is to achieve crop productivity according to its genetic ability while maintaining organic content in the soil in the long term [3].

2.3. Information Media

Information media is media as everything that can be used to channel messages and message senders to message recipients, in order to stimulate thoughts, feelings, attention, and interests and attention of message recipients, so that the information media process can be conveyed as expected [4].

2.4. Design Thinking

This method is known as a comprehensive thinking process that concentrates on creating solutions that begin with a process of empathy for a certain human-centered need towards a sustainable innovation based on the needs of its users [5].

The Design Thinking method has 5 stages [6], which are as follows:

a. Empathize

The first stage is Empathize, which is the main process. Empathize means understanding the user in the context of the purpose of the product being used. At this stage, we must understand the problems felt by users by conducting observations and interviews first.

b. Define

Define means to define or determine, which is the process of analyzing and understanding the various insights that have been obtained in empathy, with the aim of determining the problem statement as the point of view or main concern in the research.

c. Ideate

Ideate means collecting ideas related to the solution of the problem that we have defined at the define stage. This stage is a transitional process from problem formulation to problem solving, in this ideate process will concentrate on generating ideas or ideas as a basis for making prototype designs to be made.

d. Prototype

At this stage, a prototype or initial design of the appearance of the application or product to be built will be built. In its application, the initial design made will be tested on users to obtain appropriate responses and feedback to improve the design.

e. Testing

This stage is the last stage, but it does not mean the last. At this stage, the prototype that we have created in the previous stages will be tested to collect various feedback from users.

2.5. WordPress CMS

WordPress is an open source application that is very popularly used as a blog engine. WordPress is built with the PHP programming language and MySQL database. PHP and MySQL are both open source software. Apart from being a blog, WordPress is also starting to be used as a CMS (Content Management System) because of its ability to be modified and adapted to the needs of its users [7].

2.6. UML (Unified Modeling Language)

UML is a graphical-based language for visualizing, specifying, constructing, and documenting something from a software system. By using UML, communication can be done easily and effectively between developers and users [8]. UML itself has 3 diagrams that are used in designing, namely use case diagram, activity diagram and sequence diagram [9].

2.7. System Usability Scale (SUS)

SUS is one of the most popular usability testing methods. SUS was developed by John Brooke in 1986. SUS is a usability scale that is reliable, popular, effective and inexpensive. SUS has 10 questions and 5 answer options. The answer options range from strongly disagree to strongly agree. SUS has a minimum score of 0 and a maximum score of 100 [10].

2.8. User Experience Questionnaire (UEQ)

UEQ is a UX measurement method developed in 2005 by three German IT experts, namely Bettina Laugwitz, Martin Schrepp, and Theo Held. This method uses a questionnaire to collect feedback from users when using a product. UEQ is structured in order to produce a research or test result effectively and does not take much time. With UEQ users are made to answer questions immediately and spontaneously, so making questions with in-depth material and making abstract statements about the product should be avoided [11].

3. RESEARCH METHODOLOGY

3.1. Place and Time of Research

This research was conducted in Muara Batu Sub-district, North Aceh District, by conducting a survey of 30 farmers. The survey research time was carried out in June 2022. Furthermore, after conducting surveys to farmers, website development and website testing to farmers will be carried out from July 2022 until completion.

3.2. Type of Research

This research is included in the type of research and development Research and Development (R&D) is research used to produce certain products, and test the effectiveness of these products [12]. Research (R&D) is used to develop a new product or improve existing products, what is meant by products in this context is not always in the form of hardware (books, modules, learning aids, etc.), but can also be software (software) such as programs for data processing, learning, information media, and so on.

3.3. Data Collection

To obtain the various kinds of data needed in this study, researchers used various data collection techniques, namely:

a. Literature study

Literature study is studying literature in the form of concepts or theories sourced from books, journals and articles that support the completion of this research.

b. Design design

The design of this information media is made in accordance with the desired specifications. The design concept is carried out by considering the needs of farmers as well as ease of access and presentation of information that is easy to understand.

c. Website development

Making Balanced Fertilization information media is by designing using the WordPress system, where the design is carried out in accordance with the UML diagram design, so that it is as expected.

d. Website testing

Website testing is testing the website that has been created, such as the website can be accessed and run properly by testing using the SUS (System Usability Scale) and UEQ (User Experience Questionnaire) methods.

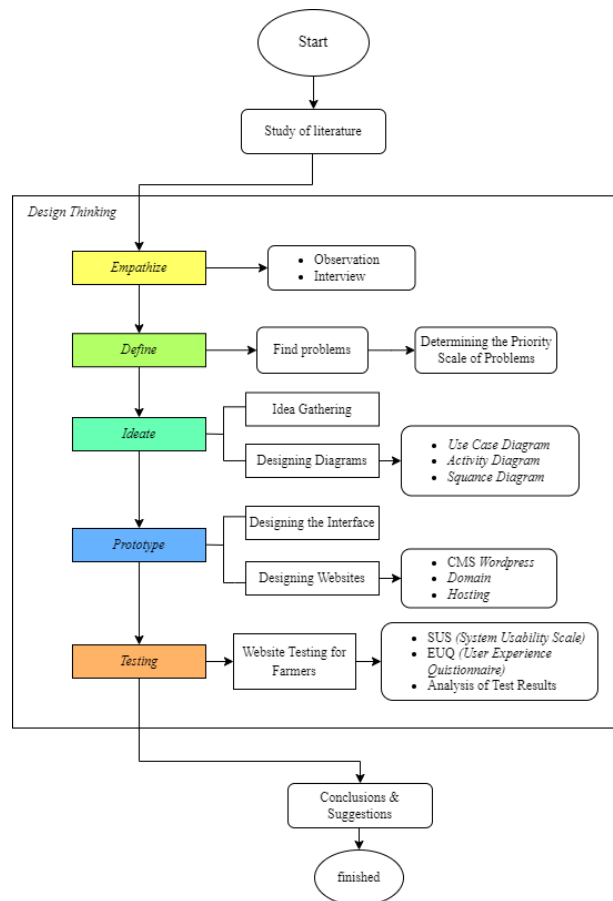


Figure 1 Research Flowchart

4. RESULTS AND DISCUSSION

In this research, a website-based information media about Balanced Fertilization will be built with the Design Thinking method as a solution to the problem that occurs in the lack of understanding of farmers about it.

4.1. Empathize

The empathize stage includes observation, and interviews with several sources who are farmers in North Aceh Regency. Thus, the main problems experienced by farmers were obtained from the survey results.

a. Observation

This stage conducts direct observations to farmers with 30 respondents located in Muara Batu District, North Aceh Regency where the majority of the community is a farmer and with agricultural commodities Rice Plants.

b. Interview

This stage conducts interviews with farmers with 30 respondents, which uses a closed questionnaire in conducting questions to respondents so that questions can be directed and make it easier for farmers to answer questions that have been given.

4.2. Define

The problem definition process is carried out by defining the problem based on the point of view technique in the following references. The process of defining the problem based on the point of view referred to based on the results of observations and interviews that have been conducted on farmers at the empathize stage, can be seen in Table 1 as follows:

Table 1. Point of View Problem Definition

User	Needs
The respondent is a rice commodity farmer.	Users want information media about balanced fertilization that can be accessed anywhere, due to the lack of understanding of farmers about balanced fertilization.

4.3. Ideate

Ideas in the process of collecting ideas at the ideate stage are taken from the previous empathize and define processes. In the ideate process, a brainstorming process is carried out and then the results of the brainstorming are described in the form of a mind map.

a. Brainstorming

At the brainstorming stage, a mind map is drawn which includes all ideas and ideas in designing balanced fertilization information media which can be seen in Figure 2 as follows:

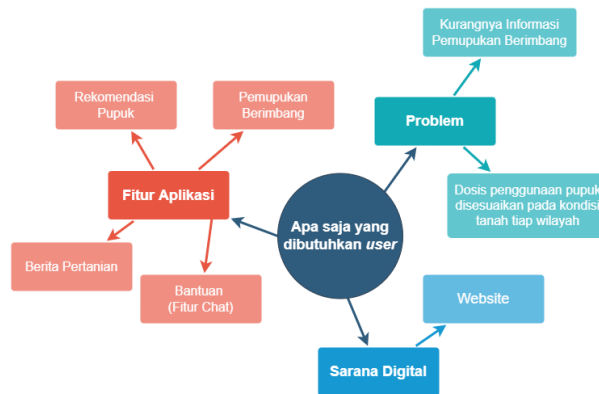


Figure 2. Mind Map Tree Diagram

b. Use Case Diagram

In building this system, researchers use use case diagrams to build applications that will be designed, where the use case diagram functions to describe the activities carried out by users in a system as shown in Figure 3 below:

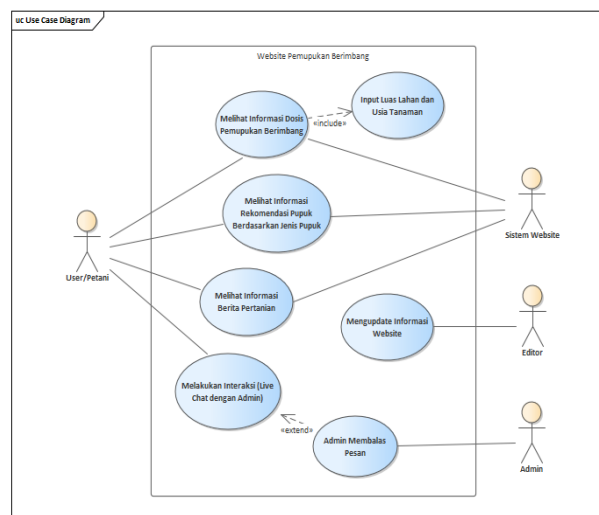


Figure 3. Use Case Diagram of Balanced Fertilization Website.

In this system, researchers built 4 main menus available on the dashboard, namely: balanced fertilization dose menu, fertilizer recommendation menu, agricultural news menu, and live chat menu (help). Users can search for information from the balanced fertilization website as desired.

c. Activity Diagram

Activity Diagram describes a series of flows from various activities carried out by the user, and is used to describe activities that are formed in an operation so that it can also be used for other activities.

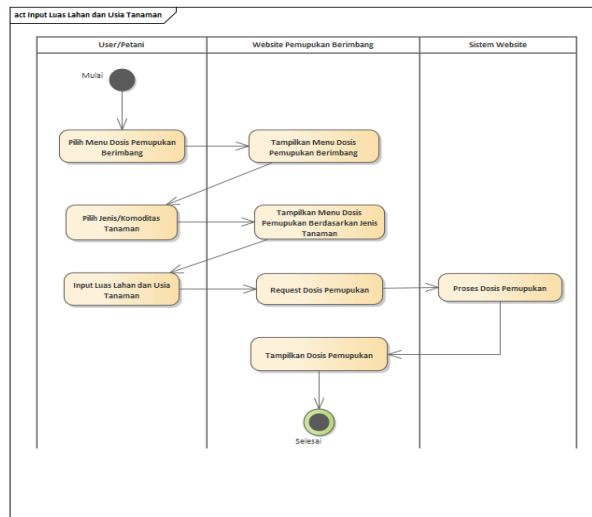


Figure 4. Balanced Fertilization Dose Menu

d. Sequence Diagram

At this stage the Sequence Diagram describes the interaction between a number of objects in a time sequence on a balanced fertilization website, the following is a sequence description for the system being designed.

1) Sequence Diagram of Balanced Fertilization Dosage Menu

In the sequence diagram of the balanced fertilization dose menu describes the flow of activities of a number of objects, which starts by selecting the balanced fertilization menu on the main page of the website.

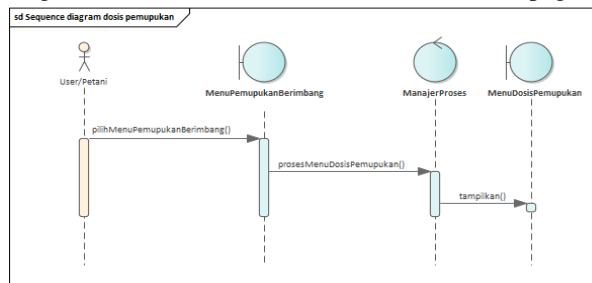


Figure 5. Balanced Fertilization Dosage Menu

4.4. Prototype

At the prototype stage, website design is carried out starting from designing user interfaces to developing website-based balanced fertilization information media.

a. Logo Design for Website

At the logo making stage, the author designs a logo with a simple appearance and can be remembered easily. In the logo there is an icon that symbolizes rice as a symbol of prosperity and prosperity and there is the word "Balanced Fertilization" which emphasizes that this website is designed to present information about balanced fertilization, as well as the tagline "The Right Solution, Increased Harvest!" stating that the use of fertilizers in accordance with the needs of plants will increase crop yields and plant productivity.



Figure 6. Balanced Fertilization Website Logo

b. Prototype Interface Design

At the stage of designing a prototype website interface, it is carried out to provide an overview of the website display design which will be used in the development of website-based balanced fertilization information media. The website design is as follows:

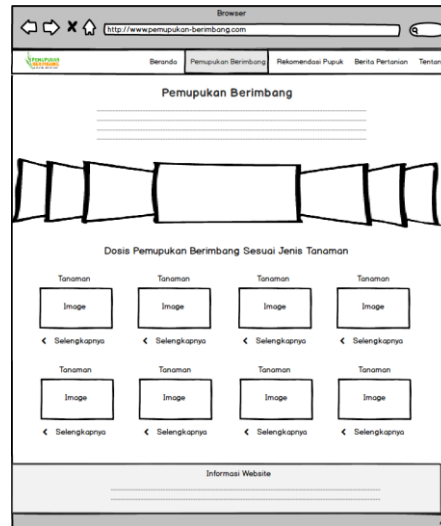


Figure 7. Balanced Fertilization Menu Page

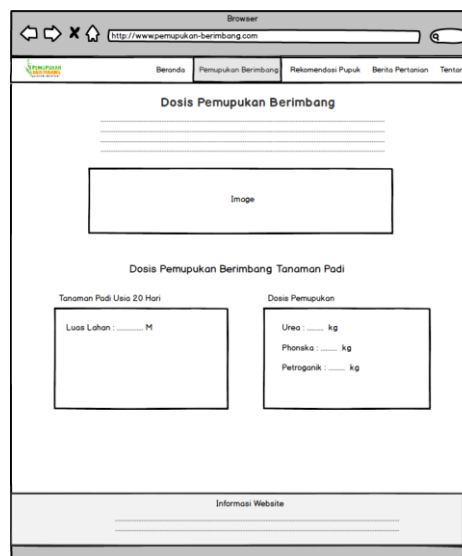


Figure 7. Design of the Input Interface for Land Area and Planting Age.

c. Website Development

At the website development stage, development and design are carried out based on the results of the design in the previous stage, as for some of the things needed in developing this website, namely as follows:

1) Domain

Domain itself is used as a URL address on the website. In the development of balanced fertilization information media, the following URL address is used: www.pemupukan-berimbang.com. With this URL address, users just need to enter the domain address into the browser and the website will display the information.

2) Hosting

Hosting itself is used as a website database storage, meaning that the greater the hosting capacity, the more media we can present to the website. For hosting in the development of balanced fertilization information media itself, using hosting with unlimited capacity that has been subscribed to the hosting tenant service.

3) WordPress CMS

WordPress CMS is used to design how the appearance and what media will be displayed on the website and designed through this application, in doing the design requires plugins or tolls that have been integrated in this WordPress CMS application including Elementor which is used as a toll to design the appearance of the website, Astra as a plugin that presents many themes that will be used on the website, and there are many other plugins needed in the development of this website-based balanced fertilization information media.

d. Implementation of Website Development

At this stage, researchers implement the website-based balanced fertilization information media that has been finished along with an explanation of the functions located on the balanced fertilization website, which are as follows:



Figure 8. Main Page Display (Home) of Balanced Fertilization Website

On the main page (Home) of this website, displays information that is useful for users, where each menu displays information if the user clicks on the available menu and a user friendly display that makes it easier for users to understand the contents or content on the main page of the website.

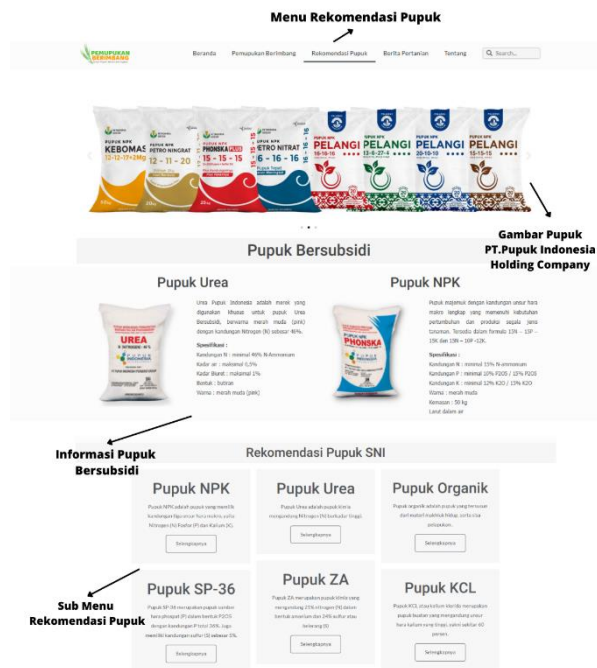


Figure 9. Main Page Display of Fertilizer Recommendation Menu.

On the balanced fertilization dose page on this website, displays information about the dose of balanced fertilization according to the type of plant that can be inputted by the needs of the land area and the age of the plant that can be selected by the user and uses subsidized fertilizer as a suggestion for using balanced fertilization.

4.5. Testing

At the testing stage in the design thinking method, we will test the website produced at the previous stage. The process of testing this website, researchers use 2 ways of testing using the SUS (System Usability Scale) testing method to measure and get the performance value of the feasibility of a website and UEQ (User Experience Questionnaire) to measure the level of user experience of a website quickly using a questionnaire. This aims to validate the success of the website so that it can be used effectively and satisfies the user or meets the eligibility standards.

At this stage, testing was carried out on 15 respondents who were in North Aceh Regency and were farmers. The reason for choosing the number of respondents is because it can represent half of the respondents who were surveyed at the beginning. Furthermore, respondents are asked to use or run a website that has been designed previously so that respondents can answer the questions that will be asked, so that later the results will be obtained from testing using these two testing methods.

a. US (System Usability Scale) Testing

In system usability scale testing there are several steps. The following are the steps of SUS testing:

- 1) Questions in odd order are questions that have a positive tone. Then the score obtained from the user is reduced by 1.
- 2) Even-order questions are negative questions. Then the score is calculated by 5 which is reduced by the score obtained from the user.
- 3) After calculating the results of the value of each question, all the results are summed up and the total result is multiplied by 2.5 to get the value of each respondent.

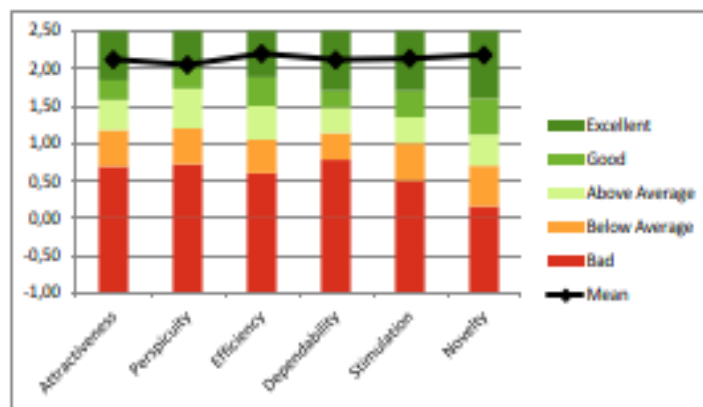
Table 2. Sus Value Calculation

Based on the test results above, it shows that the average value of SUS testing is 86.83 by leading to an excellent or very good category value. Therefore it can be concluded that from the results of SUS (system usability scale) testing on a balanced fertilization website, getting a performance value of 86.83 and included in the excellent or very good category. This shows that the balanced fertilization website that has been created is acceptable and feasible to use by users.

b. UEQ (User Experience Questionnaire) Testing

At the User Experience Questionnaire testing stage, calculations are carried out using the UEQ Data Analysis Tool version 10. After the data is collected by testing the user, data analysis is carried out to determine the benchmark value of the data obtained.

Table 3. UEQ Analysis Tool Data Transformation Calculation Results

Table 3. UEQ Analysis Tool Data Transformation Calculation Results**Figure 10.** UEQ Scale Benchmark Results of Balanced Fertilization Website.

Based on Figure 14, it can be seen that the results of the benchmark value of the balanced fertilization website get an Excellent score on the aspects of attractiveness, efficiency, clarity, dependability, stimulation, and novelty.

As for each benchmark value obtained on the balanced fertilization website, namely: attractiveness aspect gets an average value (2.12), perspicuity aspect gets an average value (2.05), efficiency aspect gets an average value (2.20), dependability aspect gets an average value (2.12), stimulation aspect gets an average value (2.13), and novelty aspect gets an average value (2.18).

5. CONCLUSION

Based on the results of the discussion that has been presented previously, it can be concluded that this research succeeded in developing website-based balanced fertilization information media, and can improve design performance using design thinking methods with SUS (system usability scale) testing scales getting excellent or very good results, and UEQ (user experience questionnaire) testing getting excellent or very good benchmark results on 6 UEQ aspects. Based on the test results using SUS (system usability scale), the balanced fertilization website gets a performance value of 86.83 and is included in the excellent or very good category. Based on the results of testing using UEQ (user experience questionnaire), the results of the benchmark value of the balanced fertilization website get an excellent value (very good) on the perspicuity aspect getting an average value (2.05), the efficiency aspect getting an average value (2.20), the dependability aspect getting an average value (2.12), the stimulation aspect getting an average value (2.13), and the novelty aspect getting an average value (2.18). This shows that the balanced fertilization website that has been made is acceptable and feasible to use by users.

AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design. Data collection and analysis were performed by Subhan, Syamsul Bahri and Khairul Anshar. Web design and features done by M. Saptariawan and Syukriah. The first draft of the manuscript was written by Khairul Anshar and Syamsul Bahri. All authors read and approved the final manuscript.

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REFERENCES

- [1] D. Nursyamsi, "Kementerian Pertanian: Petani Muda Hanya 2,7 Juta Atau 8 Persen," *bisnis.tempo.co*, 2020. .
- [2] Balittanah, "Pengertian pemupukan berimbang," *litbang. pertanian*, 2013. .
- [3] H. Kaderi, "Teknik pengolahan pupuk pelet dari gulma sebagai pupuk majemuk dan pengaruhnya terhadap tanaman padi," *Bul. Tek. Pertan.*, vol. 9, no. 2, pp. 47–49, 2004.
- [4] A. S. Sadiman, "Media Pendidikan pengertian, pengembangan dan pemanfaatannya," 2006.
- [5] A. A. Razi, I. R. Mutiaz, and P. Setiawan, "Penerapan Metode Design Thinking Pada Model Perancangan Ui/Ux Aplikasi Penanganan Laporan Kehilangan Dan Temuan Barang Tercecer," *Demandia J. Desain Komun. Vis. Manaj. Desain, dan Periklanan*, vol. 3, no. 02, pp. 219–237, 2018.
- [6] T. Brown and B. Katz, "Change by design," *J. Prod. Innov. Manag.*, vol. 28, no. 3, pp. 381–383, 2011.
- [7] S. Mukrodin, M. Kom, and others, "LAPORAN PELAKSANAAN PENGABDIAN KEPADA MASYARAKAT: MEMBUAT BLOG DENGAN WORDPRESS UNTUK GURU SMK BOARDING SCHOOL BREBES," 2019.
- [8] W. Gata and G. Gata, "Penerapan Bahasa Pemrograman Java Dalam Sistem Informasi Penjualan Versi Desktop," *J. BIT (Budi Luhur Inf. Technol.)*, vol. 10, no. 1, 2013.
- [9] S. Suendri, "Implementasi Diagram UML (Unified Modelling Language) Pada Perancangan Sistem Informasi Remunerasi Dosen Dengan Database Oracle (Studi Kasus: UIN Sumatera Utara Medan)," *Algoritm. J. Ilmu Komput. Dan Inform.*, vol. 2, no. 2, p. 1, 2019.
- [10] A. Saputra, "Penerapan Usability pada Aplikasi PENTAS Dengan Menggunakan Metode System Usability Scale (SUS)," *JTIM J. Teknol. Inf. dan Multimed.*, vol. 1, no. 3, pp. 206–212, 2019.
- [11] M. Schrepp, "User experience questionnaire handbook," *All you need to know to apply UEQ successfully your Proj.*, 2015.
- [12] P. D. Sugiyono, "Metode Penelitian Kuantitatif Kualitatif dan R&D, Bandung: CV. ALVABETA," 2009.