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Research Article

Design Thinking and Cognitive Walkthrough for Website User Experience Improvement

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A B S T R A C T

Desa Linggar located in the Rancaekek sub-district, Bandung Regency has implemented a website that functions as a medium of public information needed by the Desa Linggar community. In implementing the website, its user interface (UI) and user experience (UX) should meet the user's needs. However, the use of the Desa Linggar website is still not effective, especially in disseminating information to the Desa Linggar community, because the UI/UX of the website is still less attractive. Thus, this study evaluates and improves the UI/UX on the Desa Linggar website using the design thinking method, cognitive walkthrough to test the prototype, UEQ (User experience Questionnaire) with the target respondent before repairing 45 respondents and the target after repairing six respondents and adopting the gestalt principle to design improvement method according to user psychology. The results of the research on the Desa Linggar website obtained a learning ability value of 90%, effectiveness of 0.10 or 10%, and efficiency of 0.02 with users completing 2% of each given task and evaluating the user experience of improvement using the UEQ questionnaire with an average value of scale. Efficiency 2,583, stimulation 2,458, attractiveness 2,306, perspicuity 2,250, Dependability 2,125, and novelty 1,833 with “excellent” rate intervals.

1. INTRODUCTION

The utilization of information and communication technology (ICT) in the field of government is usually called E-Government. E-Government becomes important along with the development of existing technology [1]. The development of E-Government in Indonesia is carried out by accessing several 543 regional government sites [1]. The website is an information service that many internet users access because it can handle the requests of many users with good quality [2]. With the development of E-Government in Indonesia, Desa Linggar which is a village located in Rancaekek District, Bandung Regency has implemented a website that functions as a public information medium in which there is the information needed by the Desa Linggar community, information about activities - Desa Linggar activities and as a means of information on budget issues so that there is budget transparency between Desa Linggar parties and Desa Linggar On the Desa Linggar website, which has problems with the User interface (UI) and User Experience (UX) on the Desa Linggar website. The problem for users on the Desa Linggar website is that the interface that is displayed is not attractive to users, not simple in placing the layout, it does not meet design rules that are in accordance with user psychology, it is difficult to find the articles & news needed because users have to search for articles & news one by one. one by one and because there is no search menu to filter the titles of articles & news sought on the Desa Linggar website so that the flow in finding articles & news on the Desa Linggar website is still confusing, the use of finding the latest information on the Desa Linggar website is still not easily found by users and is still integrated with old information so it is difficult to find the latest information because the layout of the Desa Linggar website is still lacking in highlights for the latest information section, a lot of empty space, causing a lot of

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scrolling on the Desa Linggar website and a lot of content that is not important only makes a full and concise appearance. The content on the Desa Linggar website is not well structured. Thus, to improve the user experience on the Desa Linggar website, UI/UX improvements should be made. UI/UX improvement in this study uses the design thinking method because it influences how decisions are made, which will produce new and innovative ideas [3]. The design thinking method can solve complex problems and analyze the user's desires in depth [4]. UI/UX improvements in this study will produce prototypes and designs that are in accordance with user needs by adopting Gestalt principles. Gestalt principles are psychological theories that explain how ordinary humans see objects, the process of perception through organizing components that have relationships, patterns, or similarities that are put together, determine the most effective visual elements in certain situations, direct the user's attention and cause changes in user behaviour [5]. Therefore, the results of improvements in this study will require testing using the cognitive walkthrough method. Cognitive walkthrough is a method that focuses on ease of design to learn through tracing [6]. This method requires representative tasks, a complete list of task completion sequences, and a description of the background assumptions of the prospective users [7]. This study will focus on analyzing and improving the user interface design on the Desa Linggar website that users need to improve user experience using design thinking and cognitive walkthroughs.

2. METHOD

This study uses the design thinking method to evaluate and improve UI/UX on the Desa Linggar website, cognitive walkthrough to test prototypes, UEQ (User Experience Questionnaire), and Gestalt Principles for design improvement methods according to user psychology. There are 5 stages of the Design Thinking method: empathising, defining, ideating, prototype, and testing. Empathize is the stage to explore and understand user problems by approaching the distribution of questionnaires using the provisions of the User Experience Questionnaire (UEQ) combined with the System Usability Scale (SUS) and conducting interviews with users. [9]. The interview questions were grouped based on do, think, feel, pain, and gain. [10] Thirteen questions were used to create an empathy map. Interview questions can be seen in Table 1.

Table 1. Interview Questions

ID	Question	Criteria
P01	*How do you find the information you need about Desa Linggar?*	*Do*
P02	*Why do you use the website to get information?*	*Do*
P03	*What do you do after getting this information?*	*Do*
P04	*Are you satisfied with the information displayed or provided by the Desa Linggar website?*	*Feels*
P05	*In your opinion, what features are less effective on the Desa Linggar website?*	*Says*
P0	*What advice do you give if you experience complaints, discomfort in using it, or dislikes found on the Desa Linggar website?*	*Says*
P07	*How do you feel when you use the Desa Linggar website to view information?*	*Feels*
P08	*Is the information on the Desa Linggar website valid?*	*Feels*
P09	*Is the information displayed on the Desa Linggar website easy to understand for users?*	*Feels*
P10	*Are you having trouble finding what you're looking for?*	*Pain*
P11	*Are there any obstacles to using the Desa Linggar website? If so, what are the obstacles?*	*Pain*
P012	*What do you think needs to be improved or that needs to be improved so that it is easy for people of all ages to find the information they need on the Desa Linggar website?*	*Gain*
P013	*What do you think the Desa Linggar website needs?*	*Gain*

Define is the stage for analyzing the problems faced by users and analyzing user needs. [11]. Supporting data at this stage is the results of the empathize stage data in the form of an empath map from interviews with six user personas and data from the UEQ questionnaire. Ideate is the stage of generating ideas or solutions as a basis for making prototypes [10]. This study was conducted to look for design ideas and determine design ideas that fit the problem based on using Gestalt principles. The prototype is the initial display that is made to represent the actual scale before it is developed. In this research, the process of designing a wireframe (low-fidelity) is carried out which functions as a sketch of the initial display, and then making a visual wireframe (high-fidelity) that follows the rules of Gestalt principles [12]. The website prototype testing in this study used the cognitive walkthrough method for the test method. The testing phase serves to ensure that the website created is running properly [13]. Finally, conclusions are drawn from the test results that are tested on the user.

3. RESULT AND DISCUSSION

Desa Linggar is a village located in the Rancaekek sub-district, Bandung district, with the development of technology in the field of E-government, Desa Linggar has implemented a website that functions as a public information medium in which the Desa Linggar community needs the information, information about activities that carried out by the Desa Linggar and a means of information regarding budget issues so that there is budget transparency between the Desa Linggar party and the Desa Linggar community. The appearance of the Desa Linggar website before it was repaired can be seen in Figure 1.

3.1. *Empathize*

At this stage, the technique used for data collection is by distributing questionnaires to users of the Desa Linggar website using Google Forms and conducting interviews with 6 users of Desa Linggar website [14]. To find out more about the problems faced by Desa Linggar website users and to find out more about the needs of Desa Linggar website users. At the empathize stage, questionnaires will be collected to complete the research data. This study uses the UEQ questionnaire to assess the user experience of the Desa Linggar website users. According to the UEQ, 20-30 respondents have given fairly stable results for the assessment [15] With that questionnaire given to 45 respondents who have used the Desa Linggar website [14].

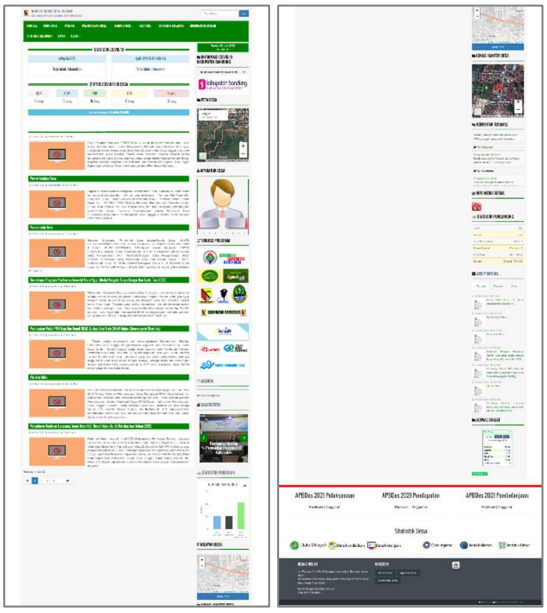

Figure 1. Interface of Desa Linggar website

The following assessment was tested on respondents used in the UEQ. The average results of the 6 UEQ questionnaire scales for the Lingar village website can be seen in Figure 2 and Table 2.

Table 2. The average score of the UEQ scale before redesign

Attribute	Mean	Variance
Attractiveness	*0.459*	*0.82*
Perspicuity	*-0.161*	*1.77*
Efficiency	*0.289*	*0.80*
Dependability	*0.661*	*0.72*
Stimulation	*0.478*	*0.75*
Novelty	*-0.428*	*1.65*

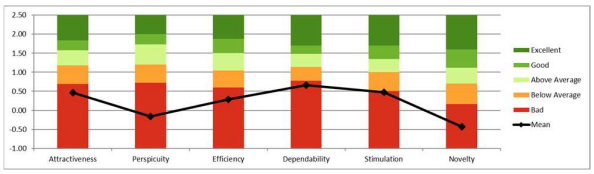

Figure 2. UEQ result of Desa Linggar Website before improvement

The benchmark interval of the average scale on the UEQ explains the results of the user experience benchmark of the Desa Linggar website, based on the average interpretation that can be seen in Figure 4 it can be concluded that the Desa Linggar website is at the "bad" level because the Desa Linggar website from the calculation results does not reach 0.7 on each scale which only reached the “bad” interval value [16].

3.2. *Define*

At this stage, an analysis of the problems users face is carried out, followed by user needs analysis. The supporting data at this stage is the result of the empathize stage data in the form of an empathy map from interviews with 6 user personas and questionnaire data [17]. The results of the empathize including interviews and questionnaires can be concluded that the problems faced by the Desa Linggar community can be seen in Table 3.

Table 3. User experience problem of Desa Linggar Website

ID	*Problems*
PM01	*It is difficult to find the articles & news needed because users have to search for articles & news one by one and because there is no search menu to filter the titles of articles & news they are looking for on the Desa Linggar website so the flow of searching for articles & news on the Desa Linggar website is still confusing*
PM02	*The use of the latest information search on the Desa Linggar website is still not easily found by users and is still integrated with old information. Hence, it is difficult to see the latest information because the Desa Linggar website is layout still lacks highlights for the latest information section.*
PM03	*There is a lot of white space, causing a lot of scrolling on the Desa Linggar website, and a lot of unimportant content that only makes the full view, for example, 3 Desa Linggar maps have the same function*
PM04	*The content on the Desa Linggar website is not well structured according to the Gestalt Principles UI*
PM05	*The interface displayed on the Desa Linggar website is still unattractive and does not meet design rules that are by user psychology*
PM06	*There is no agenda menu to find out the agenda that the Desa Linggar will carry out*

Analysis of user needs resulting from the problems experienced by users so that the improvement of the Desa Linggar website is by the needs of its users [18]. the needs of the Desa Linggar website users can be seen in Table 4.

Table 4. User Needs of Desa Linggar Website

ID	Needs
KB01	*An attractive interface that must be up to date, following the latest UI trends, simple layout placement, modern typography, and meeting design rules according to user psychology,*
KB02	*Search menu to make it easier for users to filter articles & news titles which will make it easier to find articles & news on the Desa Linggar website*
KB03	*Added the latest information highlight to make it easier for users to find the latest information needed*

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KB04 *Eliminate content that has the same function or move content to reduce white space to minimize scrolling on the Desa Linggar website*

KB05 *Well-structured layout according to Gestalt principles UI*

KB06 *Added an agenda menu to find out what agenda the Desa Linggar will carry out*

3.3. Ideate

The results of interviews conducted by researchers with 6 user personas of the Desa Linggar website, obtained input that can be considered for improving the UI/UX of the Desa Linggar website. To describe ideas, inputs, and solutions using brainstorming using six thinking hats mapped in mind mapping [19]. After the brainstorming has been carried out, it is mapped in the form of a mind mapping to get ideas or solutions that can be used in improving the design of the Desa Linggar website which can be seen in Figure 3 and Table 5.

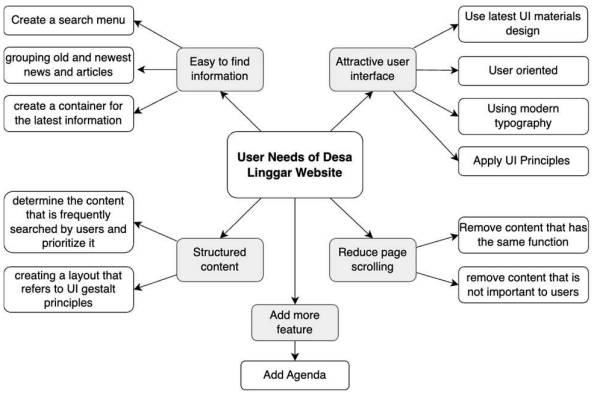

Figure 3. User Needs Mind Map

Table 5. Solution Ideas

ID	Solution Ideas	Related-Needs	Related-Problem
D01	*An attractive appearance is in accordance with the rules of Gestalt principles.*	*KB01*	*PM05*
D02	*Added a search menu, and a special container for up-to-date information.*	*KB01, KB02*	*PM01, PM02*
D03	*Simplify content by eliminating elements that are not important for users to find and create a layout that refers to Gestalt design principles.*	*KB05*	*PM04*
D04	*Eliminate or move content with the same function and reduce white space by maximizing the layout that refers to Gestalt principles.*	*KB04*	*PM03*
D05	*The agenda menu to make it easier for users to find the agenda that the Desa Linggar will carry out*	*KB06*	*PM06*

3.4. Prototype

Low-fidelity prototype was built based on the Gestalt Principles which is according to the ideate stage. This low-fidelity prototype was made by referring to the sitemap and user flow created at the ideate stage. The focus of improving the appearance of the Desa Linggar website is only on the home page because the home page is the most frequently accessed by users. The low-fidelity wireframe proposed in this study can be seen in Figure 4.

According to the low-fidelity prototype, as can be seen in Figure 5, a high-fidelity wireframe was built by applying UI material design such as fonts used using 1 type of font, using multiples of 8 sizes, margin or padding using multiples of 8. applying the gestalt principle in layout placement, flow used, object placement, illustrations used, proximity or the distance between elements, grouping content, similarities in existing elements on display and applying the concept of symmetry in the gestalt principle. High-Fidelity Wireframe can be seen in Figure 5.

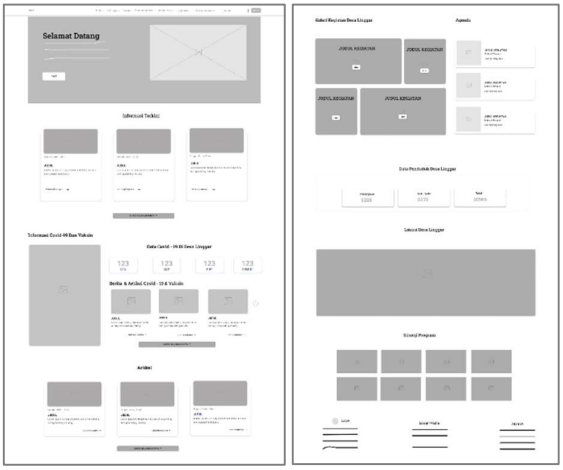

Figure 4. Low-fidelity prototype

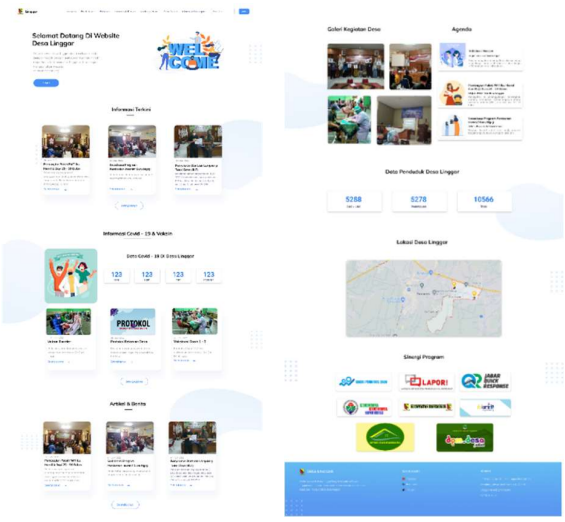

Figure 5. High-fidelity prototype

In this high-fidelity wireframe, the blue colour is used according to colour psychology, symbolizing loyalty, honesty, professionalism, and calm [20]. Besides, the blue colour represents the purpose of the Desa Linggar website so that there is data transparency between the Desa Linggar party and the community to create honesty, openness, and professionalism in being responsible for the Desa Linggar which accordance with the meaning of the blue colour psychologically. The focus of

improving the appearance of the Desa Linggar website is only on the home page because the most frequently accessed by users.

3.5. Testing

The cognitive walkthrough method is used to test the prototype in this stage. This phase begins with creating a task scenario that the respondent will carry out for testing. There are 6 respondents test the prototype scenario by the functionality of the Desa Linggar website which has the scope of the previous user persona, after determining the test respondent will Prototype testing was carried out respondents by going directly and trying out the prototype that had been made, after testing the prototype, an analysis of the problems faced by users during the trial was carried out, after analyzing the problems respondents would be given a questionnaire, this test was carried out to collect feedback from respondents who have tested, the value obtained from the respondent will be processed into the final result to find out whether the improved prototype has a better value after the redesign. There are seven task scenarios which will be tested by the user in this testing phase as can be seen in Table 6.

Table 6. Task Scenario

ID	Tasks	Steps
T01	*Look for self-serve logins*	*2*
T02	*Looking for the latest information*	*2*
T03	*Looking for vaccine information*	*2*
T04	*Looking for a news collection*	*5*
T05	*Search the activity gallery*	*2*
T06	*Look for the Desa Linggar agenda schedule*	*2*
T07	*Looking for the location of the Desa Linggar*	*2*

There are six respondents whose conducted prototype testing on the Desa Linggar website, 6 respondents have completed 6 scenario tasks that have been made and 6 respondents have difficulty completing 1 scenario task, namely task 4 with a scenario of Desa Linggar who need past news collection information. . 4 respondents can complete the task with appropriate stages while 3 respondents can complete task 4 not by the stages, in completing task 4 respondents experienced achievement time with an average of 00:19 seconds to 00:27 seconds because according to respondent feedback on task 4, it is difficult to find past news, it is too complicated which must be filtered first, making time inefficient. The flow searching for old news is still confusing and does not directly list what is being addressed. Respondent settlement data can be seen in Table 7.

Table 7. Task Completion

Code	T01	T02	T03	T04	T05	T06	T07
RS-01	*S*	*S*	*S*	*S*	*S*	*S*	*S*
RS-02	*S*	*S*	*S*	*S*	*S*	*S*	*S*
RS-03	*S*	*S*	*F*	*F*	*S*	*S*	*S*
RS-04	*S*	*S*	*S*	*S*	*S*	*S*	*S*
RS-05	*S*	*S*	*S*	*F*	*S*	*S*	*S*
RS-06	*S*	*S*	*S*	*F*	*S*	*S*	*S*

3.5.1. Cognitive Walkthrough Testing Result

Analysis of test results obtained from user testing results from completing tasks given on the Desa Linggar website testing. The analysis of the test results is divided into three components, namely measuring the level of learnability, measuring the level of effectiveness, and measuring the level of efficiency[21].

Learnability

Scenario completion is measured by the number of scenarios the respondent can complete. The assessment used to measure the level of completion is S (success) which means that the respondent can complete the task according to the stages that the researcher made, F (Failed) which means that the respondent can complete the task that is not by the stages that the researcher made. To assess the aspect of learnability can be obtained by calculating the level of success. The success rate assesses the percentage of task scenarios that can be completed correctly. Data on completion of scenario tasks from 6 respondents and 7 tasks with 38 successes and 4 failures can be seen in the table. 6.

$$Success\ Rate = \frac{Task\ Completed\ Successfully}{Total\ Tasks\ Performed\ x\ Total\ Respondents} \quad (1)$$

$$Success\ Rate = \frac{38}{42}\ x\ 100\% = 90\%$$

Based on the data on completing the task scenario, the percentage of success rates was 90% from 100%. According to [16] the average task completion rate is 78%. These results indicate that the level of learnability of the Desa Linggar website is still above average.

Effectiveness

The respondent's error rate when testing the Desa Linggar website prototype was calculated to assess the effectiveness aspect.

$$Error\ Rate = \frac{Number\ Of\ Error}{Total\ Number\ Of\ Task\ Attempts} \quad (2)$$

$$Error\ Rate = \frac{4}{42}\ x\ 100\%$$

$$= 0{,}10 = 10\%$$

According to the error rate calculation results on the Desa Linggar website, the error rate obtained was 0.10 or 10% of 100%. According to [22] the average error value per task is 0.7. This shows that the error rate on the Desa Linggar website is still above average.

Efficiency

To measure efficiency, we conducted the completion time of the task, where the time is in the form of seconds needed by the user to complete the task [23]. The efficiency level can be calculated by calculating the efficiency of the time limit. Time is calculated for each task that the respondent has completed. Completion time recapitulation can be seen in Table 8.

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Table 8. Task Completion Obtained

Code	T01	T02	T03	T04	T05	T06	T07	Total Sec
RS-01	3	8	9	20	3	3	4	50
RS-02	1	4	9	19	2	4	2	43
RS-03	2	12	16	27	7	3	7	74
RS-04	6	4	5	19	3	3	9	49
RS-05	2	5	9	20	5	7	14	55
RS-06	5	8	9	24	5	5	9	65
MIN	1	4	5	19	2	3	2	**Total**
MAX	6	5	16	27	7	7	4	336

The result of the calculation of the efficiency of the time limit is 0.02 task scenarios per second. This shows that on average every second the respondent can complete 2% of each given task. The results of this improvement get a more excellent value than research [24] which obtained an efficiency level of 0.07 with an average of every second the respondent can complete 7% of each given task scenario.

3.5.2. UEQ Result

After testing, respondents will be asked to fill out a questionnaire using the UEQ, which has 6 scales: attractiveness, clarity, efficiency, accuracy, stimulation, and news. The data obtained is from the results of questionnaires that test respondents have filled out. Questionnaires were given to 6 respondents who have the same characteristics as the user persona. The average results of the 6 UEQ questionnaire scales for the Desa Linggar website can be seen in Table 9.

Table 9. The average score of the UEQ scale after the redesign.

Attribute	Mean	Variance
Attractiveness	*2.306*	*0.56*
Perspicuity	*2.250*	*0.93*
Efficiency	*2.583*	*0.37*
Dependability	*2.125*	*0.34*
Stimulation	*2.458*	*0.29*
Novelty	*1.833*	*1.09*

Table 8 shows the result of calculating the average value of the scale on the UEQ for improving the Desa Linggar website including the average value of attractiveness, clarity, efficiency, accuracy, stimulation, and novelty. To check the user experience level of the Desa Linggar website by comparing the UEQ measurements for each scale, it is presented in a benchmark diagram divided into five categories: excellent, good, above average, below average, and bad.

According to the testing results on 6 respondents who have conducted trials and filled out the UEQ questionnaire. The results of the UEQ questionnaire that have been filled out by 6 respondents with an average value of above 1.7 are obtained, where the improved Desa Linggar website is at the "excellent" level, this improvement has increased [25]. A comparison of the old design and the new design shows that the improvement of the Desa Linggar website has a higher value and has increased from the previous design. The comparison is taken from the average value of UEQ by comparing the parameters of attractiveness, clarity, efficiency, accuracy, stimulation, and novelty. UEQ score before and after repair can be seen in Table 10 and Figure 9.

Table 10. The average score of the UEQ scale before and after the redesign

Attribute	Before	After
Attractiveness	*0,459*	*2,306*
Perspicuity	*-0,161*	*2,250*
Efficiency	*0,289*	*2,583*
Dependability	*0,661*	*2,125*
Stimulation	*0,478*	*2,458*
Novelty	*-0,428*	*1,833*

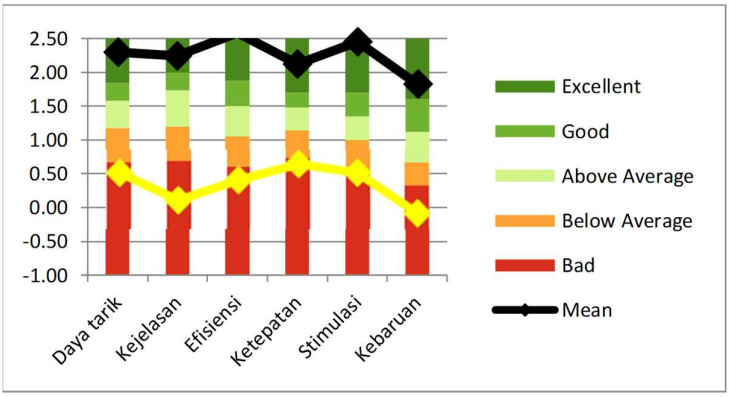

Figure 9. UEQ Result of Desa Linggar Website Before and after improvement

A comparison of testing results using UEQ with the same questions after the redesign can be seen in Figure 9. The improvement of the UEQ score was caused by adopting the Gestalt principle of the user interface. The common region,

invariant principle, and grouping principle [5]. Therefore, improvements can encourage the user experience by influencing several factors such as practical, fast, organized, useful, interesting, fun, comfortable, user-friendly, easy to learn, and innovative, which lead to the improved user experience of the Desa Linggar website.

4. CONCLUSION

In this study, the design thinking method is used to map problems, the user needs identification, find and obtain ideas to be developed on the prototype to get a high-fidelity prototype. The average value before improvement using UEQ with an accuracy scale of 0.661, stimulation 0.478, attractiveness 0.459, efficiency 0.289, clarity -0.161, and novelty -0.428 where the value before improvement is at the "bad" level interval. Improvements to the user interface of the Desa Linggar website were conducted through user needs analysis, followed by brainstorming using mind mapping to generate the ideas that have been obtained, and finally adopting Gestalt principles to create a design that is in accordance with the psychology to improve user experience on the Desa Linggar website users. Ideas that have been obtained are then developed on low-fidelity and high-fidelity prototypes. Prototype usability test evaluation was carried out using the cognitive walkthrough method which obtained a learnability value of 90%, an Effectiveness value of 0.10 or 10%, an efficiency of 0.02 with users completing 2% of each given task, and an evaluation of the user experience of improvement results using the UEQ questionnaire with an average value. The average efficiency scale is 2.583, stimulation is 2.458, attractiveness is 2.306, clarity is 2.250, accuracy is 2.125, and novelty is 1.833 where the improvement results are in the "excellent" level interval.

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