

Redesign E-learning with User Centered Design Method for Improved Accessibility Students

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Abstract–E-learning is learning with information technology in providing material and interaction between teachers and students. In the application of e-learning must have easy access for students and teachers because it will affect teaching and learning activities. However, in the application of e-learning, there are still difficulties felt by students as has been implemented in MTsN 16 Jakarta. Based on questionnaires and interviews conducted at the beginning of the study which was attended by 30 respondents obtained results where the e-learning used had difficulty in finding assignment forms, task deadlines, and discussion forums by obtaining an SUS score of 42.9. In this case, a redesign is needed to solve the problems perceived by the user. This research uses user-centered design (UCD) in design development because UCD focuses on users to meet user needs and can improve the ease of accessing e-learning based on user needs, in addition to the development of redesign e-learning will take references based on users and e-learning that has been used before. The e-learning redesign prototype will be tested using the System Usability Scale (SUS) followed by 61 respondents. From the test results using SUS got a result of 80,82 which is included in the good and acceptable category. This research also shows that redesigning e-learning using UCD can facilitate access and learning activities carried out by students.

Keywords: E-learning; User Centered Design; System Usability Scale

1. INTRODUCTION

Madrasah Tsanawiyah Negeri (MTsN) 16 Jakarta is a junior high school under the Ministry of Religious Affairs, MTsN 16 Jakarta has implemented e-learning for teaching and learning activities since 2020. E-learning is learning that uses information technology in providing material and interaction between teachers and students. E-learning has many challenges for students and educators. In the development of e-learning there are several aspects that need to be considered, especially aspects of User Interface (UI) and User Experience (UX) as ease of students in using e-learning[1]. In the context of e-learning development, usability is considered an important quality factor that evaluates the interface and experience of using e-learning [2]. Based on interviews and initial questionnaires conducted at MTsN 16 Jakarta, it was found that the use of e-learning still had obstacles, where the obstacles were students had difficulty in finding assignment forms, difficulty seeing deadlines and difficulty in accessing discussion forums given by teachers. And based on the results of the usability test using a system usability test followed by 30 respondents gave a system usability test result of 42.9. Where from these problems it can be concluded that there are problems that occur in usability and user experience felt by students so that redesign needs to be done to improve usability and user experience felt by students. This research focused on developing user experience in MTsN 16 Jakarta students using the user centered design method where according to [3] in the development of e-learning using the user centered design method can help in understanding user empathy and purpose. The designs that have been made using user-centered design will be tested using a usability test system that is expected to get a score above 70 (acceptable). MTsN 16 Jakarta has problems in using E-learning including students having difficulty in finding assignment forms, assignment deadlines and discussion forums given by teachers which results in ineffective teaching and learning processes using e-learning even though the purpose of e-learning itself is to facilitate the learning process of a student. According to [4] describe that the use of e-learning is still limited to some features such as the undetailed description of assignment submission and assignment feedback or discussion forum given by the teacher, which makes students experience difficulties and confusion in using e-learning. It can be concluded from these problems that there are problems in the e-learning design, so it is necessary to redesign e-learning to improve user experience and usability.

In this study, the question raised is how to improve usability in e-learning user experience by redesigning using the User-Centered Design method with the system usability scale calculation method. The sample of the research test was students from MTsN 16 Jakarta who used e-learning in the teaching and learning process, this study used google form tools to collect samples from MTsN 16 Jakarta students. In addition, this research is only focused on improving the design of student displays, the final result of this research is a running prototype designed using the User-Centered Design method. According to [5] user-centered design is a method that focus on user, the method can be increase the efficiency from user and all requirements and process from user. In addition, this study will focus only on the appearance of the user interface and experience of students because of the problems raised first where students experience difficulties that result in difficulties in teaching and learning activities. Therefore, by redesigning the MTsN 16 Jakarta e-learning, it is expected to improve the user experience and usability of the e-learning, in addition to the development of the MTsN 16 Jakarta e-learning design, it will reference user needs such as mental models, Hierchical Task Anaylisis from users, and style guides on e-learning that have been running, this is done so that students can adapt quickly to the new system, besides that by focusing on student users, the results of the designs that have been made can improve good user experience and good usability for users, namely MTsN 16 Jakarta students and make a easier for learning experience for students. Therefore, the use of the user centered design method is expected to increase needs, user experience and goals that are adjusted by

users and focus on users. And based on research from [6] states that e-learning design must support users in efficiency and effectiveness, e-learning design must meet several criteria, among others, visual appearance and attractive lessons, easy-to-use navigation, learning using animation and graphics. And based on research from [6] states that well-designed E-learning can improve the quality of e-learning systems and increase student acceptance of e-learning. In addition, other studies that refer to [7] Several factors affect the success of learning using e-learning argue that factors that affect success in using e-learning include the appearance (user Interface), ease of use (user friendly), ease of interaction, choice of language, completeness of features and maintaining purpose. Therefore, it is necessary to redesign e-learning so that student needs and student user experience can be improved properly. Previous research on e-learning using user-centered design. Lintang Matahari et al. [8] Stating that e-learning interface design is not just about providing a learning environment with a good interface but should include learning objects as it influences interface decisions, e-learning interface design using user centered design methods can result in positive evaluations of usability and user experience. In the development of e-learning there are several success factors for learning the use of e-learning, according to research from [7] factors that influence success are user interface, ease of user use, ease of interaction, and completeness of features. According to research from [9] explained that e-learning designed for education is difficult to use and difficult to understand will have an impact on user disability, and in its use users will spend little time trying to understand the system. Therefore, according to [6] well-designed e-learning can increase student acceptance in using e-learning. According to research from [10] Usability and User Experience (UX) significantly impact e-learning development and student learning. Therefore, creating a simple interface and an interface that has attractive colors and simple elements can increase user satisfaction. According to [11], in the development of e-learning design, the best way to develop is to implement according to user needs. In addition, according to [12], e-learning design must meet several criteria, including Visual Appearance, engaging subject matter, easy-to-use navigation, and learning using animation or graphics. According to [8], developing an e-learning design using User-Centered Design can produce positive evaluation results. According to [12], applying the UCD method approach to e-learning can make e-learning look more user-friendly and have a high level of usability.

2. RESEARCH METHODOLOGY

2.1 Research Stages

2.1.1 User Centered Design

User Centered Design is a method that focuses on users in the development process, using this method the system development process can adjust to user needs and in UCD development can also increase usability or satisfaction value of users [8]. Based on research from [13] states that the steps in the user centered design method are (1) Understand Context Of Use, (2) Specify Requirements, (3) Design Solution, (4) Evaluate Against Requirements.

2.1.2 System Usability Scale

The usability scale system is a method for calculating usability or user satisfaction, according to [14] the usability scale system is a fast method to use, which is the most appropriate method to be used in collecting valid data that produces clear and precise scores. According to [14] the use of a system usability scale provides valid and reliable results and evidence even with a small number of respondents, besides that the use of the results of the system usability scale can be an evaluation of a system.

2.1.3 Understand Context of Use

The first of a step in user centered design method is understand context of use, in this step will be identified to users where at this stage users will also be conducted interviews and questionnaires to find out the usefulness and conditions when using the product [15].

2.1.4 Specify User Requirements

The second step on user centered design method is specify user requirements, in this step is focuses on identifying the needs of the user [15] and at this stage will also generate like a user persona, mental model, Hierchical Task Analysis and based on from the previous step. At this stage it will also produce requirements and needs from users .

2.1.5 Design Solution

At the design solution stage, a design will be made in accordance with the needs and requirements based on the previous stage [15] and based on [13] states that at this stage a design will be made, where the design made is using mockups. So that users can see and observe the results of the design solution.

2.1.6 Evaluate Against Requirements

At the Evaluate Against Requirements stage an evaluation will be carried out on the design that has been developed at the design solution stage where at this stage it can also produce whether a user is satisfied or not with the design results

provided [15]. At this stage, testing will also be carried out using the usability scale system which will be followed by 61 people where according to [16] 15 respondents were sufficient to identify usability issues.

2.2 Research Flow

This research uses User-Centered Design in redesigning E-learning MTsN 16 Jakarta. User-centered design is a user-focused method [13]. This user role method is needed in the design process to meet users needs and result in a good user experience [17]. This method has several stages, namely Figure.1: (1) Understand context of use, (2) Specify user requirements, (3) Design Solutions, (4) Evaluate against requirements. Figure 1 is an image of the research flow using the user centered design method, where each stage has stages of the user centered design method. The Figure 1 can be seen below :

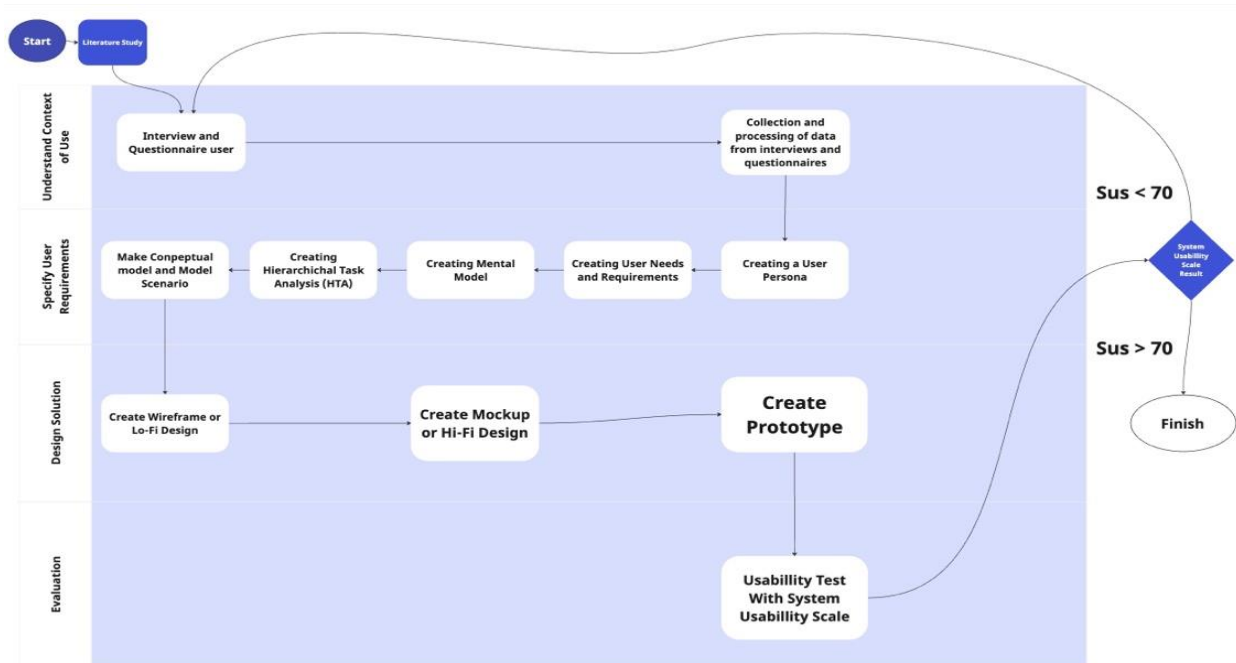


Figure 1. Design System

In Figure 1. It can be seen the system design from this study, where at each step of the user-centered design method will be carried out task tasks such as in the first stage there will be interviews and questionnaires from users, this is done to get user habits in using the system and problems that occur from users, and in the next step will be created user persona based on the previous step and will produce the needs of users, Where the needs in the previous step will be the foundation for making designs at a later stage. In the last stage, the design that has been made according to user needs will be tested using a usability scale system to measure the usability of the design that has been made.

3. RESULT AND DISCUSSION

3.1 Understand Context of Use

At the understand context of use stage, the author conducted interviews and questionnaires to MTsN 16 Jakarta students in this data collection carried out online. Interviews and questionnaires were conducted to determine students' experiences in using e-learning and interviews and questionnaires were conducted by 30 people, while the population of MTsN 16 Jakarta students consisted of approximately 500 students, which according to research from [16] stated that in conducting usability testing, 15 people can be used to analyze usability problems, besides that according to research from [16] also said that testing using 20 people will produce results that are not much different by using more respondents. In this case, 30 respondents were used to find out the problems of students and the usability of e-learnin. After conducting interviews and questionnaires, data can be taken as a reference to understand user needs, preferences and behavior to produce better designs according to user needs.

3.2 Specify Requirement

At this stage, data analysis and problem identification are carried out aimed at designing the design. With the information that has been analyzed and identified then the next stage is the creation of user personas, according to research from [18] states that creating user personas can understand and facilitate in guiding the design process of user needs. User persona identification is taken from the results of interviews and questionnaires produce the following user personas :

Table 1. User Persona

Objectives	Persona
Bio	MTsN 16 Jakarta students who <i>use E-learning as learning material and use E-learning and material to do assignments and questions through the Discussion Forum</i>
Motivation	Students want to have E-learning that can make it easier for them to carry out learning activities at MTsN 16 Jakarta anytime and anywhere.
Goals	- Want to quickly search for assignment forms assigned by teachers. - Want to have ease in finding assignment deadline schedules. - Want to have ease in finding answers in discussion forums sent by teachers
Pain Points	Students find it difficult to find assignment deadlines and assignment forms given by teachers because there is no UI that can see the assignment design when the web is opened. In addition, students also find it difficult when they want to find answers or discussions sent by the teacher because there are no filters that make it easier for students to find the class or subject they want to find.
Needs	- Requires a design/system that can display deadlines that are easily accessible to students. - Requires a design/system that can display forms that are easily accessible to students. - Requires a design/system that can make it easier for students to find discussion forums provided by the teacher.

Table 1. The user persona that has been created above is obtained on the needs and persona of the user obtained when interviewing and conducting questionnaires on users. Personas are used to aid in the development of e-learning. After the user persona is created, the next step is to create user needs based on the user persona that has been created, while the results of the needs needed by users are as follows:

Table 2. User Needs

Needs	Requirements
Getting convenience in finding the task deadline.	- Added task <i>timeline</i> feature to <i>e-learning</i>. - Add task deadline feature easily visible.
Getting convenience in finding task forms	- Added an easily accessible form collection feature.
Get ease in finding discussion forums provided by teachers	- Added a discussion forum feature that focuses on specific classes.

Table 2 can be seen as the result of user needs taken from user personas, where these needs will be an illustration when creating user-focused designs. The results of the design made must also be based on the needs of the user. As for some features that are not problematic in e-learning that have been running will still be maintained, here are the features that are maintained:

1. Calendar feature that students use to view academic calendar information
2. The grade feature is used by students to see grades in registered classes.
3. Computer based test feature to conduct exams given by teachers.
4. Profile feature used to view profiles of students
5. Features of learning materials used by students to access materials provided by the teacher.

After all user needs are obtained, the next stage is the creation of a mental model, where the function of the mental model itself is to show how the user achieves achievement for an activity performed. According to research from [18] states that the user's mental model if understood will facilitate the design of the system to be created. Making mental models refers to research references [18] where for student mental models can be seen in appendix 2. The next step at this stage is the creation of Hierarchical Task Analysis (HTA), HTA is used to understand the tasks to be done by users by describing tasks to subtasks in order to achieve the goals to be carried out by users. According to research from [19] said that HTA makes it easier for UI designers to design user interfaces because there is an overview of the goals, tasks and sub-tasks of the user. After making HTA a conceptual model is made to explain the tasks and subtasks of the HTA made. The results of making mental models from students can be seen in Figure.2. According to [18] to represent the expectation and mental user for using an application mental model must be build and mental model can make a easier for developer make a design.

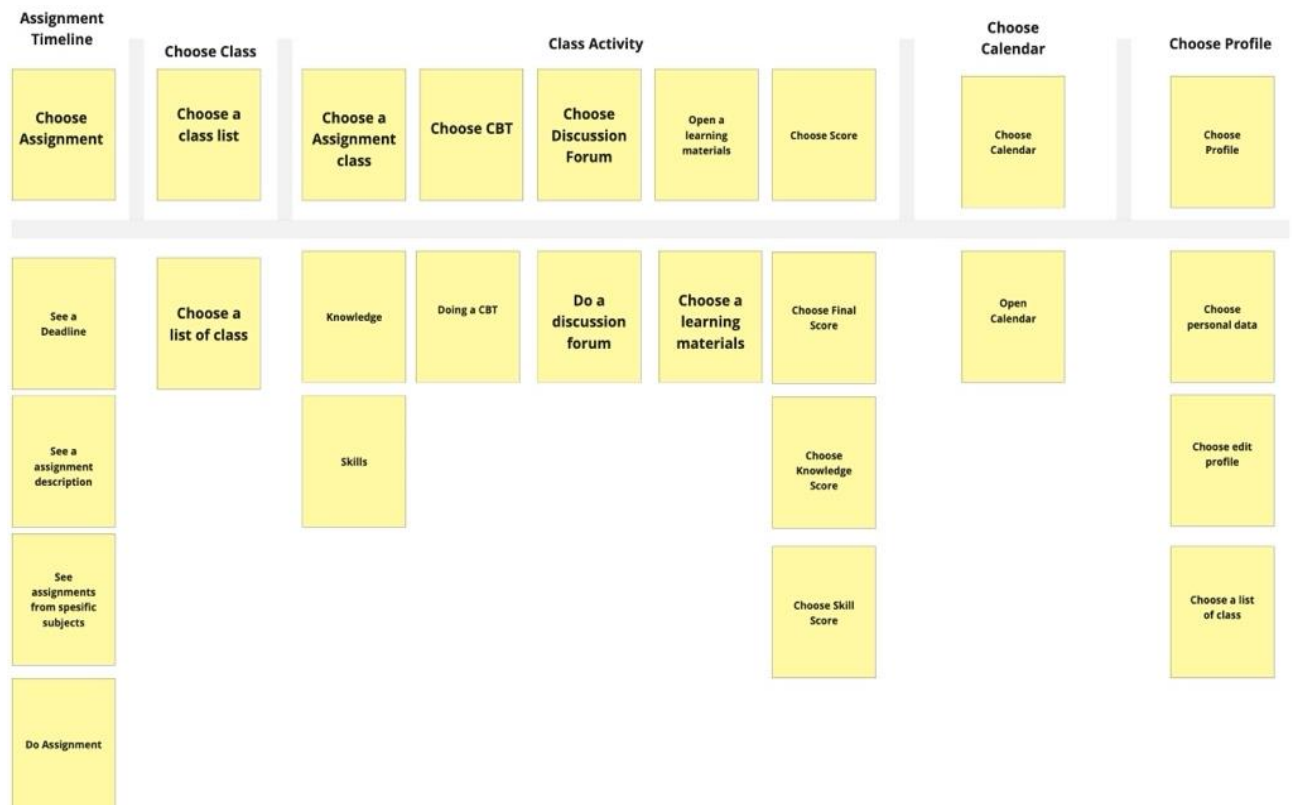


Figure 2. Mental Model

Hierarchical Task Analysis can be seen in Figure 3. where HTA is taken based on the mental model of the user, namely MTsN 16 Jakarta students. The function of HTA is to analyze the tasks that will be done by users when using an application, besides that the use of HTA can also make it easier for developers to develop task designs or features from users

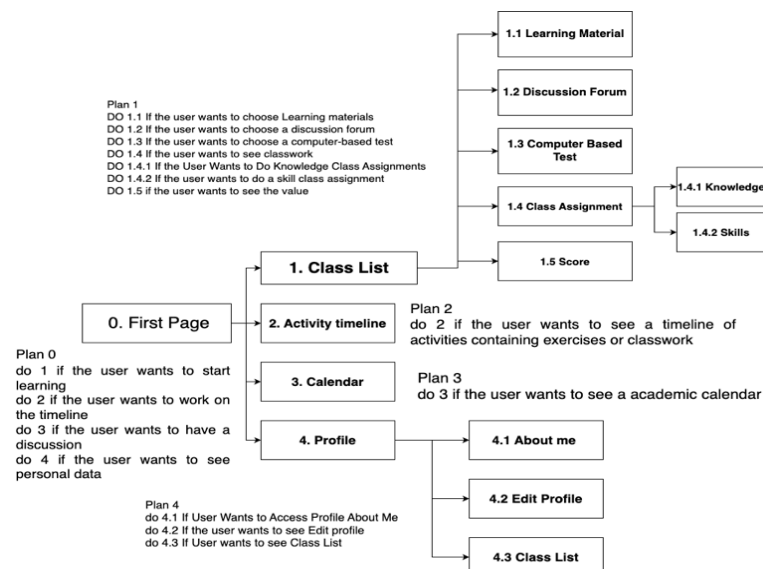


Figure 3. Hierarchical Task Analysis.

3.3 Design Solution

At this stage, the next step is to create a design solution consisting of wireframe or low-fidelity creation and high-fidelity design mockups. After that, the last stage of development is the creation of a prototype. In making mental user interface models, HTA, context scenarios and conceptual models are used to design designs based on previously identified user needs. According to [12] user interfaces have important uses in running software systems and According to [15] user experience with a clear and well-designed conceptual model will facilitate as well as facilitate the role of design. In

addition, in making a design solution, a style guide and color guide are needed. And below is the result of the design that has been improved according to the needs and stages of the previous stage in the user-centered design method :

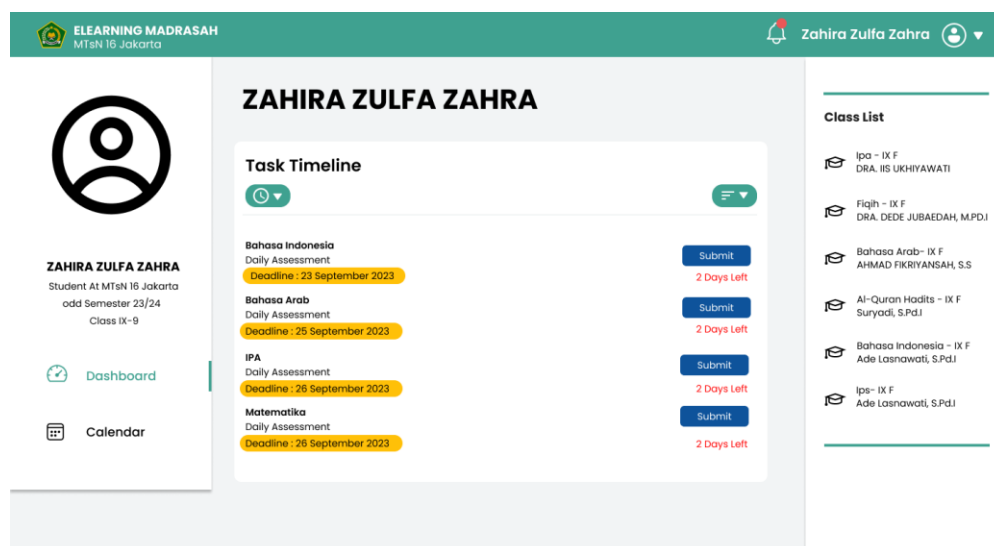


Figure 4. Design after redesign

In the picture above produced after the repair, the design after the repair is taken based on user needs where students can find assignment deadlines and assignment forms easily, the addition of deadlines on the initial page of the improved design when compared to the design before the repair where students cannot immediately see the deadline of the assignment given by the teacher this makes students sometimes missed in collecting assignments therefore a timeline of assignments is made To make it easier for students to see assignments that are active or have not been done, students can also easily see the assignment form and deadlines of assignments. In addition, some features that are still needed are maintained where there are still notifications and profiles located on the navbar and the class list feature located on the right sidebar, this is made so that students can still see the list of registered classes when opening the main page. In addition, there is a feature that is still maintained, namely the calendar where the calendar feature is placed on the left sidebar so that students can still see the calendar easily.

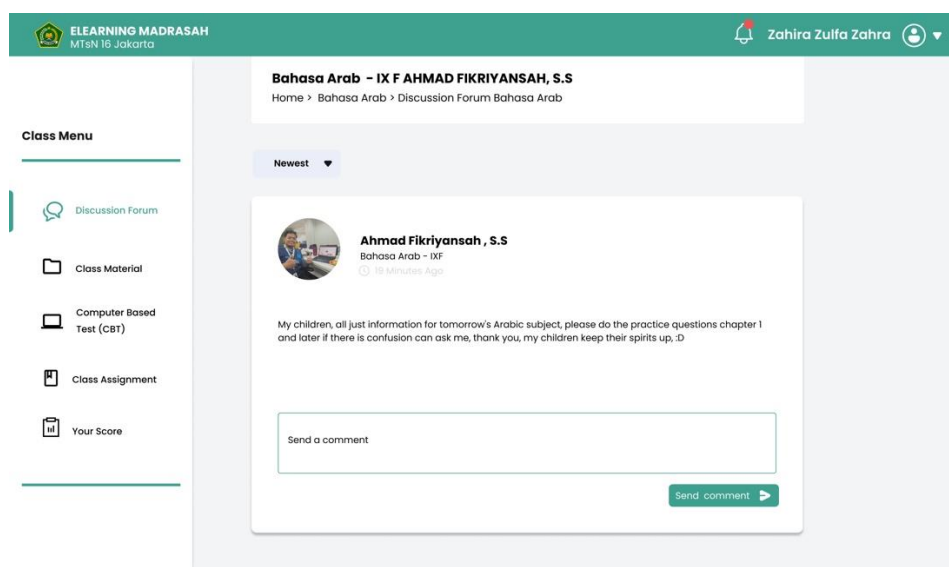


Figure 5. Design discussion forum after redesign

In the picture above, the design was produced before the improvement and after the improvement of the discussion forum feature, this design was taken from the user's mental model in using the discussion forum and HTA that had been made previously besides that this design was also efficient from the color guide and typography that had been made before. The discussion forum design is made based on the user's difficulty in finding a discussion forum given by the teacher, this is because the design before the improvement of the discussion forum was made one and did not focus on a particular class. This makes the discussion forum before the improvement accessible to all users such as teachers from other classes and other subjects, this makes the discussion forum can sink quickly and makes it difficult for students to

find the discussion forum provided by the teacher because the discussion forum is general and the search feature can only be searched using the class code. In the design after the improvement of the discussion forum focused only on one particular class such as in Arabic class, then those who can access the discussion forum are only registered students and teachers of the subject and students can also do sorting based on the latest and oldest discussion forum, this makes it easier for students to discuss with teachers on certain subjects.

In addition, the improved design results also maintain the features needed by students in previous e-learning such as class materials, computer-based tests, class assignments and a list of grades in e-learning before the improvement. Features in e-learning after improvement are also based on the mental model of the user. Where users can access discussion forums and class assignments, class materials, computer-based tests and grades easily on the design before the above feature improvements are placed on the navbar but in the design after the improvement the feature is moved into a sidebar this is used so that students can remain easy to access the features above and produce designs that still maintain consistency in the designs that have been improved.

3.4 Evaluate Against Requirements

The last stage of the user-centered design method is the evaluate against requirements stage where at this stage the improved design will be evaluated using a usability scale (SUS) where the SUS used is SUS which has been adapted using Indonesian by Zhafrina and Santoso [20]. The tools used to test using google form tools were followed by 30 respondents while the population of MTsN 16 Jakarta students was 500 students. The test scenarios for testing design results are:

1. Users will be given time to explore the running prototype of the improved design.
2. The user fills out the usability scale system form to assess the running prototype after exploring the running prototype on the improved design.

After the assessment has been collected, the next step is to calculate the system usability scale by means according to [21] how to calculate the system usability scale is:

1. For each question in odd order minus the number 1.
2. For each question in even order, the value is reduced starting from 5.
3. Add odd and even numbered values and multiply by 2.5.

After successfully prototyping and designing at this stage, testing will be carried out using System Usability Scale to determine whether the system created has met user needs. This test was attended by 61 respondents from MTsN 16 Jakarta students. The results of the system usability scale calculation can be seen in table 3 below:

Table 3. System Usability Scale Result

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS
R1	4	4	4	3	4	4	4	4	4	4	97.5
R2	4	3	4	4	4	4	4	4	4	4	97.5
R3	3	4	4	3	3	4	4	4	4	4	92.5
R4	4	3	4	4	3	4	4	4	4	4	95
R5	3	4	4	4	4	4	3	3	3	3	87.5
R6	3	3	1	4	3	3	3	3	1	1	62.5
R7	4	3	4	1	4	3	4	4	4	3	85
R8	3	4	4	3	4	4	4	4	4	4	95
R9	4	4	3	3	3	3	4	4	3	3	85
R10	4	4	4	1	4	4	4	3	4	4	90
...											
R61	3	4	3	4	4	4	4	4	3	2	87.5
Average Score											80.82

After obtaining the calculation results that can be seen at Table 3, the SUS score is compared with the SUS Score value in Figure 6. which refers to [22].

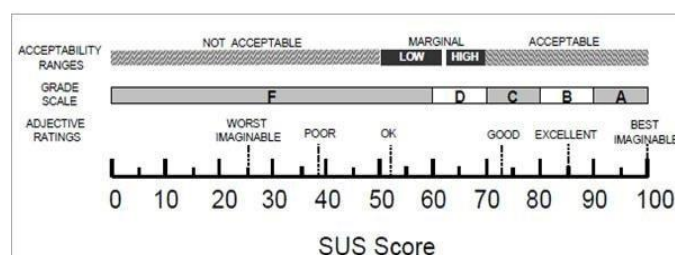


Figure 6. System Usability Score Range

Based on the value obtained from the SUS score results, which is 80.82, it is included in the good and acceptable categories. With this score, students can receive design or prototype results well with this student user experience has been said to be good. According to research from [23] usability results affect user experience. Based on the results of the score above, it provides an understanding that students can accept the design offered. Some students' difficulties in finding assignment forms, assignment deadlines and discussion forums have been handled besides that the design offered also makes students more comfortable in its use. In addition, after testing the usability scale, interviews were conducted about the entire system that had been built, the results were as follows:

1. On the task timeline, respondents think that the improved system makes it easier for users to see information about assignments given by teachers.
2. In the assignment form, respondents argue that the improved system makes it easier for users to collect assignments given by teachers.
3. Overall of the improved systems, respondents think that the features provided are more complete and make it easier for users to use e-learning.

4. CONCLUSION

Based on the results of research conducted on e-learning redesign using the user-centered design method, it can be concluded that this research has solved the problem of e-learning in MTsN 16 Jakarta which has been explained in the introduction using the user centered design method. This research was obtained based on information on problems that occur when students use e-learning through interviews and questionnaires. By using user-centered design and system usability scale in the development of e-learning redesign, MTsN 16 Jakarta can improve user experience in using e-learning. Using user-centered design can also help understand unmet user needs so that development can be easier and more accurate. The evaluation of the usability scale system and student assignments was successfully improved with the results of the usability scale system evaluation getting a score of 80.82, adjective rating: good, Grade: B and acceptability range: Acceptable where in the previous design only got a score of 42.9. Therefore, it can be concluded that students can accept designs that have been improved using the user centered design method and based on the results of the research that has been done, the advice needed is the need for iterations in usability testing to get a higher usability value. In addition, suggestions for further research are expected to focus on the appearance of the teacher where the appearance of the teacher also greatly affects learning activities for students.

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