User Interface and User Experience Design in Digital Learning Applications for Autistic Users with the Human-Centered Design Method

Muhammad Iman Nurdin [1] *, Muhammad Ashar [2], Muhammad Iqbal Akbar [3], I Putu Dody Lesmana [4]

[1] *Universitas Negeri Malang, Indonesia*

*Corresponding author's e-mail: muhammad.iman.1705356@students.um.ac.id

Abstract

Currently in Indonesia there are millions of school-age children. Some of them still have difficulty in accessing education, including children with special needs. Children with special needs are part of a society that is classified as vulnerable. Some institutions state that they are 10 times more likely to be out of school. Even when they go to school, the learning they receive tends to be not optimal, especially for autistic children. Autism is a disorder of overall human development that results in barriers to socialization, communication, and behavior. With the various obstacles they have, the learning process they receive tends to be less than optimal if it is not balanced with adequate facilities and infrastructure. Therefore, in this study, researchers want to design a digital learning application for autistic users based on a website, where the User Interface (UI) and User Experience (UX) of the learning application are tailored to the user's needs. By using the Human-Centered Design (HCD) method that focuses on humans in its manufacture. With these grounds and reasons, it is hoped that this research can produce a UI UX with a good level of usability, effectiveness, and user satisfaction.

Keywords: UI UX; Autism; Human Centered Design.

I. Introduction

Currently in Indonesia, there are millions of school-age children. Some of them still have difficulty in accessing education, including children with special needs, especially people with disabilities. According to the 2019 National Education Basic Data, there are around 95,000 students with disabilities in Indonesia, of which 63% are male students and 37% female students [1]. Children

with disabilities are part of society that is classified as vulnerable. Several institutions stated that they were 10 times more likely to be out of school. Data from the 2010 census noted that only 53% of people with disabilities had education compared to 98% of those without disabilities [2]. Even when they go to school, the learning they receive tends to be not optimal, especially for children with autism disabilities.

Autism is a disorder in human development as a whole that results in barriers to socialization, communication, and behavior skills [3]. Rahayu also explained that the disturbances they experienced ranged from mild to severe. Symptoms of autism generally appear before the child reaches the age of 3 years. Therefore, schools have an important role as a form of early handling of autistic children, which aims to overcome the developmental delays in them according to their age development.

Digital learning applications for autism are a form of learning media for children with special needs with autism that are specifically designed to facilitate their needs, according to their abilities and potential. The success of a digital learning application depends on how well the perception is received by the user. User interface and user experience in digital learning applications is one of the important factors that influence the success or failure of digital learning applications for autistic users. Because anything designed human-centered based on psychology, physiology, sociology, and other sciences that analyzes human life will produce a product that will not only be good but also functional according to the psychological characteristics and distinctive features for a large group of users [4].

Based on the explanation above, the researcher wants to design UI and UX in digital learning applications for autistic users by using the Human-Centered Design (HCD) method that focuses on humans in its manufacture. With these grounds and reasons, this research hopes to increase the level of usability, effectiveness, and user satisfaction of digital learning applications for autistic users.

II. Method

Human-Centered Design (HCD) is an approach or method in system design and development that aims to create useful interactive systems with a focus on system use and the application of human factors [4]. This approach improves efficiency, effectiveness, user satisfaction, and user convenience. This approach is oriented to humans as users so that the UX Designer knows what the user needs in real and directly [5]. The reasons for using human-centered design include reducing discomfort and stress, increasing usability, and most importantly improving the user experience [6].
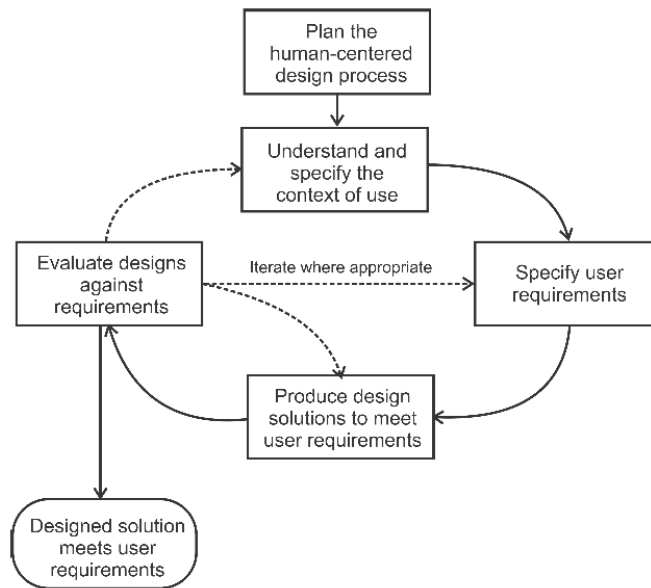
Figure 1. Human-Centered Design Method

Figure 1 describes the steps in the HCD method. The HCD method starts with understanding people first and knowing what their needs are. To be able to understand people or users, observations can be made first. In the HCD approach, iterations are carried out in order to achieve what the user needs. In the HCD iterative cycle there are 4 stages, namely user characteristics analysis, user needs analysis, designing solution design, and finally the solution design evaluation stage [7]. The following is a description of the four stages:

1. Analysis of user characteristics

   The first activity carried out in this cycle is observation, with observations we can find out the problem to be solved. In this activity, direct observations are made to users, monitor their activities, try to find out their interests, motives, and needs. In this activity, researchers are guided by Human Considerations in Design which consists of several important points observed, namely: user knowledge and experience, user tasks and needs, user psychological characteristics, and physical characteristics of the user [8]. The definition of the problem being searched for can be known by understanding what the goals are to be achieved by the users and the obstacles or obstacles they face.

2. Analysis of user needs

   In the user needs analysis stage after the problem to be solved is known, the next step or activity is to generate potential solutions to existing problems. In this phase creativity is needed, we are as free as possible to brainstorm in order to find solutions that can be applied to these problems. Don Norman gives some rules to follow [7]:

   a. Generate as many ideas as possible

b. Be as creative as possible without paying attention to boundaries

c. Ask Anything

3. Designing solution design

The idea that has been generated in the design phase of the solution design is made into a prototype so that it can be tested directly with potential users. The prototype used may still be in the form of sketches from the results of doodles or those that have been made using tools such as figma. Prototyping in problem determination can tell that the problem to be solved is understood by the user.

4. Evaluate solution design

In this activity, gather several people to do testing so that it can be seen that the solutions provided to users have resolved the problem or not. Testing can be done by inviting one or more people to try the prototypes that are already available. In usability testing, the best test results are obtained from tests with the number of participants not more than 5 [9]. This testing stage is important to study user behavior and find out which parts are still not right and can be improved in the next iteration.

III. Results and Discussion

The application design that had been made previously was tested on 15 evaluators consisting of assistant teachers at UM Autism SLB, UI UX designers, and app developers. The application design that has been made is also tested on 6 users who are autistic students at the UM Autism SLB Laboratory. The following is a task flow that is given to evaluators and users to work on:

1. See page about : Home – About

2. View lesson options: Home – View lesson options

3. Study chapter 1: Home – Choose a lesson – Choose Part 1 – View Material – Practice Question 1 - Practice Question 2 – Practice Question 3 – Practice Question 4 – Practice Question 5 – Practice Question 6

4. Study chapter 2: Home – Choose a lesson – Choose Part 2 – View Material – Practice Question 1 - Practice Question 2 – Practice Question 3 – Practice Question 4 – Practice Question 5 – Practice Question 6

5. Study chapter 3: Home – Choose a lesson – Choose Part 3 – View Material – Practice Question 1 - Practice Question 2 – Practice Question 3 – Practice Question 4 – Practice Question 5 – Practice Question 6

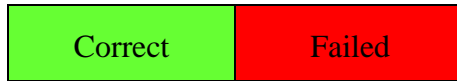The level of success of the user in carrying out the given task, categorized by the color code described in figure 2

Correct	Failed

Figure 2. Category Test

Figure 2 is two categories of usability testing with the following indicators:

1. Correct: the respondent is able to do the task well.

2. Failed: the respondent failed in carrying out the task that had been given.

a. Usability Aspect

The usability aspect of the application that has been made is evaluated using a heuristic evaluation method and with a severity rating scale. The heuristic evaluation was carried out in two iterations.
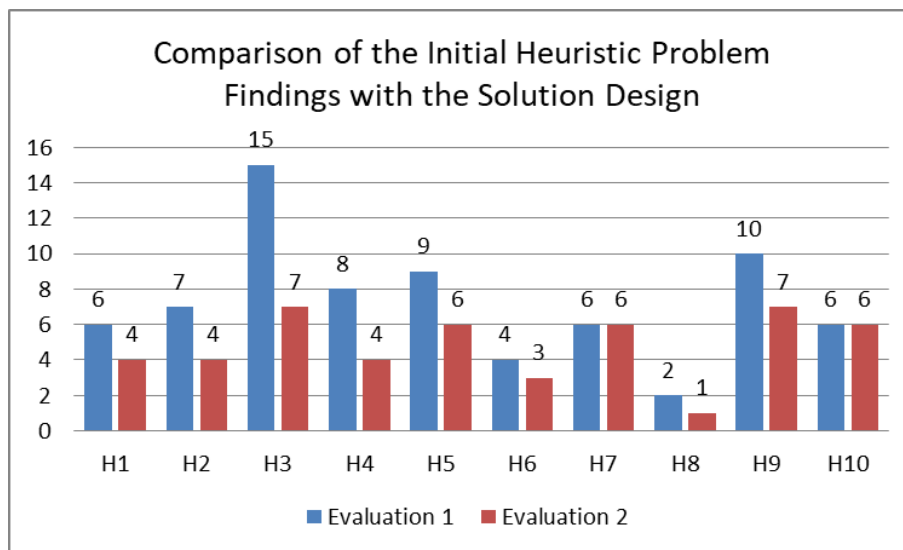

Figure 3. Comparison Diagram of Problem Findings in Stages 1 and 2 Evaluation

The diagram in Figure 3 shows a decrease in the number of problem findings in the evaluation of stage 1 and stage 2 (solution design). The decrease is quite significant in almost every aspect of the heuristic. This indicates that the evaluators are satisfied with the improvements made to the solution design.
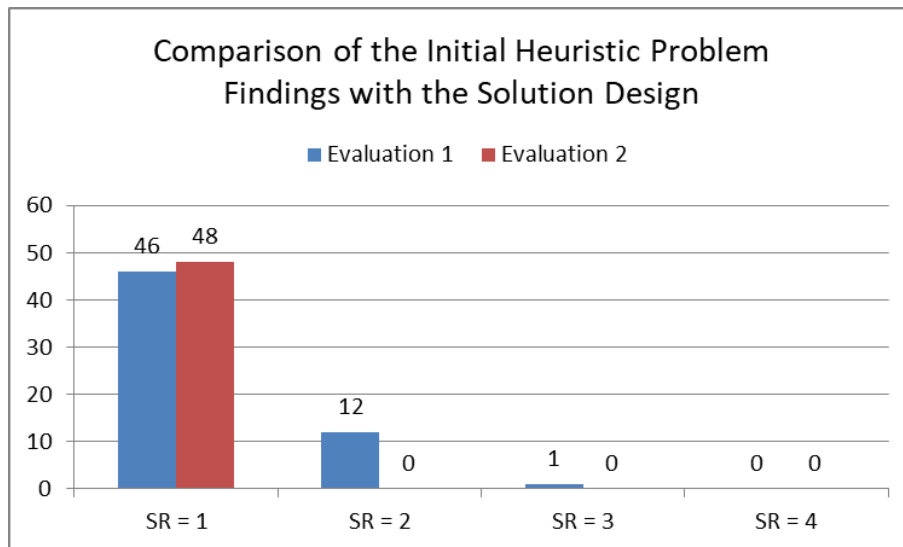
Figure 4. Comparison Diagram of Total Severity Ratings in Stage 1 and 2 Evaluations

The diagram in Figure 4 shows a comparison of the number of findings from the level of severity or severity ratings in stage 1 and stage 2 evaluations. Based on the diagram above, it can be seen that there is a decrease in the number of problem findings with severity ratings 2 and 3 in the evaluation of stage 1 to stage 2, but an increase in the number of finding problems with severity ratings of 1 in the evaluation of stage 1 to stage 2 is also found due to a decrease in the severity of each heuristic aspect which originally had severity ratings 2 and severity ratings 3 became severity ratings 1. This shows that the evaluators are satisfied with the improvements made to the solution design, but there are still finding problems in the solution design but with a severity level of 1 which is a cosmetic problem category, that is, the problem does not need to be fixed, unless there is time for improvement.

b. Effectiveness Aspect

Calculation of Effectiveness using the formula effectiveness [10], the equation is as follows:

$$Effectiveness = \frac{Number\ of\ tasks\ completed\ successfully}{Total\ number\ of\ tasks\ undertaken} \times 100\%$$
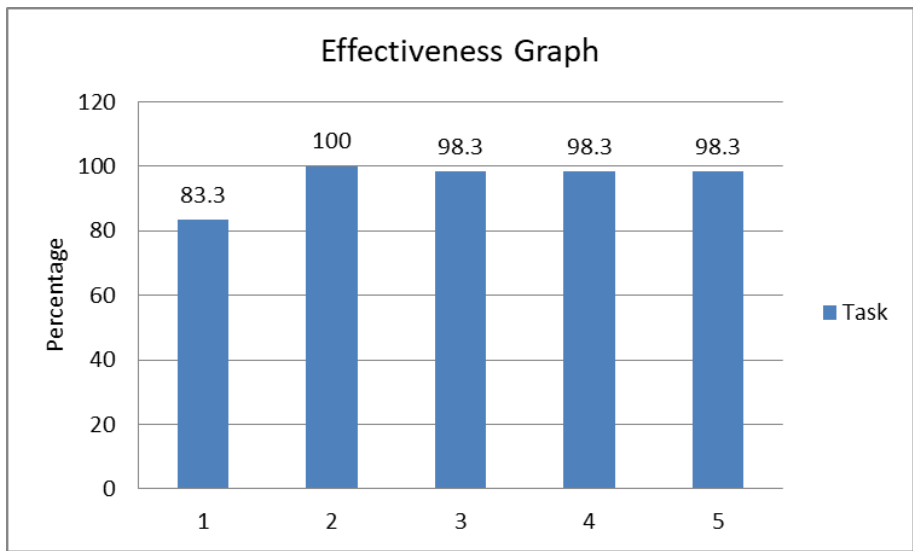
Figure 5. Effectiveness Chart

The graph in Figure 5 shows the percentage of user success in completing each given task. After testing was done, there were a total of 5 tasks that failed to be completed out of a total of 204 given tasks, as well as 199 tasks that were successfully completed. So, the calculation of the total effectiveness is:

$$Total\ Effectiveness = \frac{199}{204} \times 100\% = \mathbf{97,5\%}$$

From the results of the above calculation of 97.5%, it can be concluded that the application is successful and effective to use.

c. Satisfaction Aspect

Based on the results of the smileys scale that has been given, the level of user satisfaction is presented in the form of a diagram as follows:
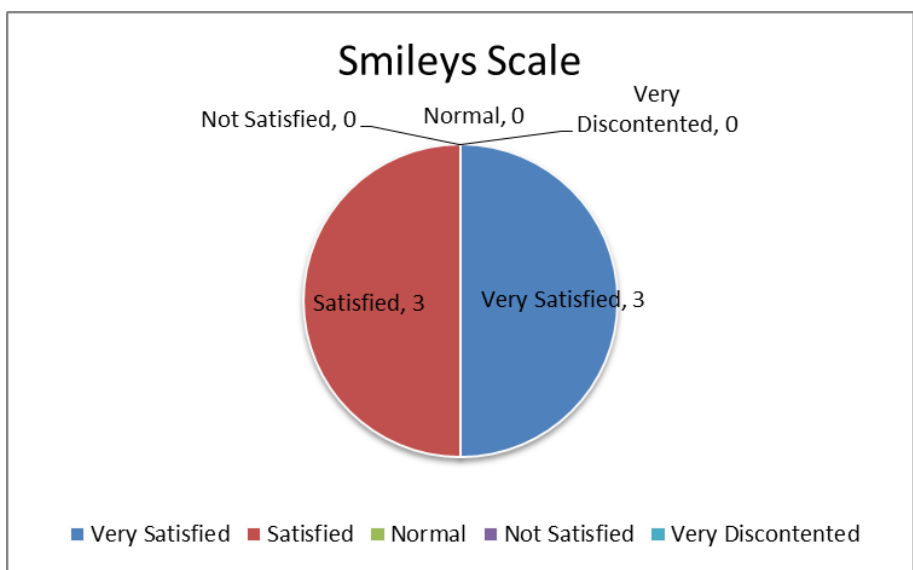
Figure 6. Smileys Scale Chart

The diagram in Figure 6 shows the answers from 6 users to the level of satisfaction after using the application that has been made. The level of user satisfaction is shown through the selected smileys. 3 people are very satisfied and 3 others are satisfied with the application that has been created. From the results of the smileys scale, it can be concluded that the application created has succeeded in making users satisfied.

IV. Conclusion

The application of the human centered design method makes the UI UX design process for this digital learning application for autistic users run well and produce applications that are effective and in accordance with the needs, habits, and capabilities of making users who are autistic students feel satisfied. Because in the process of stages, human centered design is a method that focuses on humans based on psychology, physiology, sociology and other sciences that analyze human life and interactions with the environment. This means that a human-centered product will not only be good but also functional according to the psychological traits and features typical for a large group of users.

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