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Development of User Interface and User Experience in Virtual Lab Mathematics Applications Using Design Thinking Methods

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ABSTRACT

The biggest problem in the distance learning process during this pandemic is the misconception of the material delivered by teachers. So is the problem that occurs in online math learning. Problems that often arise one of them in the effectiveness of the use of tools in distance learning. The use of learning media is an essential need in this covid-19 pandemic. Virtual Lab (V-Lab) math is interactive multimedia-based software that is operated with hardware and can simulate activities in the laboratory. The design of interface design (UI) and user experience design (UX) are crucial stages in software development. Design Thinking is an innovation-based product design method that relies on finding solutions to solve problems in a particular product design. In building V-Lab, Math used design thinking methods to create interface design with five stages: empathize, define, ideate, prototype, and Test. UI / UX design in the V-Lab Math application contains material page design, figures, simulation, contact, and evaluation. System testing is done by doing component testing is testing of system components. The components tested in this study are interface

components with the black box, single ease question (SEQ) method by getting good results, effective and easy to use.

Keywords: Development, Virtual Lab, Mathematics, Design Thinking.

INTRODUCTION

Learning strategies experience the limitations of face-to-face learning due to the covid-19 pandemic. The biggest problem in the distance learning process during this pandemic is usually a misunderstanding in studying mathematical materials. The use of learning media is an essential need in this covid-19 pandemic. Multimedia teaching materials are teaching materials that are technology-based and are a combination of two or more different media [1]. These constraints are the background to the development of virtual lab (V-Lab) math applications based on interactive multimedia. A virtual laboratory is interactive multimedia-based software operated with hardware and can simulate activities in the laboratory, users will feel in the actual laboratory [2]. Various advantages in learning using virtual laboratories according to among others, as an alternative solution in overcoming the absence or limitations of tools and laboratories, is a way out in the problem of limited learning time in the laboratory, can help students who have slow learning speed because the computer can re-air the material needed by students, more interactive because it can be accessed through computers, laptops, and gadgets and can be accessed. Used independently or in groups anytime, anywhere with internet access [3]. The design of interface design (UI) and user experience design (UX) are crucial stages in the development of software [4]. User Interface (UI) is the interaction of the system with users with each other through commands and using content and entering data. User experience (UX) is an experience related to a user's reactions, perceptions, behaviours, emotions, and thoughts while using the system [5].

The creation of interface design and inappropriate user experience can cause problems in the use of the application after the end. Design Thinking is an innovation-based product design method that relies on finding solutions to solve problems in a particular product design. Design Thinking is used as one of the new methods in the interface design process. In building V-Lab Math used design thinking methods to create interface design. V-Lab Math is a virtual laboratory application of mathematics used as one of the learning media in the current covid-19 pandemic. Some scenarios are developed in the features presented in this application; such features include mathematical materials related to numbers, sets, algebraic forms, equations and linear inequalities of one variable, mathematical character recognition features, simulation features and evaluation features. In the material feature also in addition to text material provided sound speech feature to facilitate the learning of the material. The use of the

Design Thinking model as a problem-solving solution is expected to produce a prototype design that is tested according to the needs of the end users of this V-Lab Math application.

METHOD

Design thinking is a problem-solving method that focuses on users [6]. Design Thinking is an iterative and non-linear method [7]. The stages of this method are empathized, define, ideate, prototype, and test (see Figure 1).

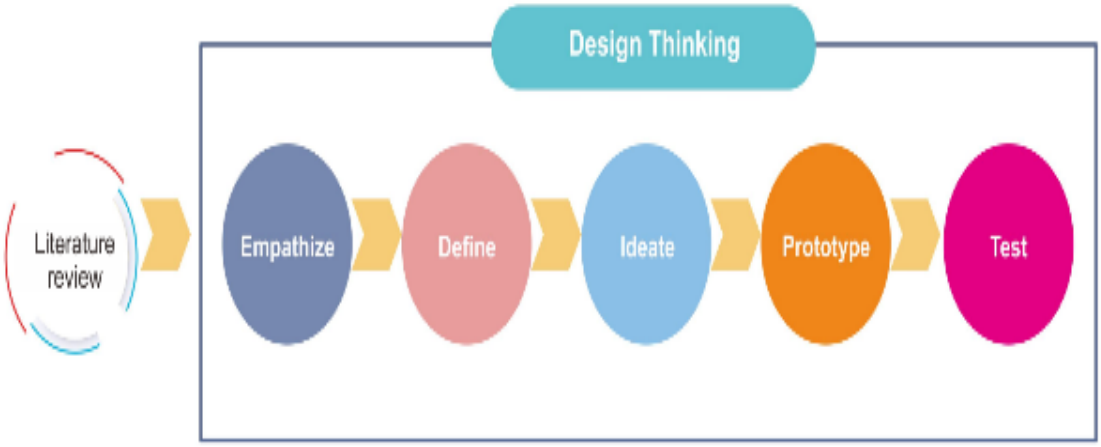

Figure 1. Research Methods

In developing the interface design, V-Lab Math adapted from the Design Thinking method as a reference, with the following process: 1) Conduct theoretical studies and literature studies related to design thinking research, 2) Build models with design thinking methods, 3) Doing the stages of UI / UX design development using design thinking method consisting of Empathize which is a process to know the needs of users by conducting interviews and observation of the needs of V-Lab Math users; Define is the process of describing the idea or user that is the basis of the application product to be built, this is done by making a list of user needs, Ideate is the process of describing the solutions needed by conducting a joint evaluation of the design team and combining the creativity of each application designer. A prototype is building or implementing an idea that has previously been obtained in the previous stage into a product that is ready to be tested. The next stage is the Test; at this stage, tested or tested on the finished application by conducting experiments on the user [7].

RESULTS

We arrange the results of this study based on the flow of 5 (five) stages of working procedures on the Design Thinking method.

1. Empathize

   In this process, activities are carried out to find out the needs of the user. The work process carried out in this stage is to conduct interviews and observations with teachers and students of class VII in SMP N 1 Pecalungan Batang Regency. Interview sessions with teachers and students are intended to reinforce the knowledge of needs teachers' and students' needs in the V-Lab Math application. Table 1 show that a list of questions asked related to the development of the V-Lab Math application.

Table 1. Questionnaire

No.	List of interview questions
1	What methods of learning mathematics are used in the covid-19 outbreak?
2	How is the process of learning mathematics during the current covid-19 pandemic?
3	What materials are presented in class VII math subjects?
4	Does it need a virtual math lab to support learning?
5	What kind of virtual application of mathematics laboratories do teachers and students expect?
6	Are there syllabuses and RPPs in class VII math subjects?
7	How long does it take each day for math learning during the current covid19 pandemic?
8	Are students and teachers familiar with using computers, laptops or gadgets?
9	Can teachers and students access the internet properly?

2. Define

The defined process is the process of getting the user's idea or view to be the basis of the application product to be developed. Table 2 show that a list of the needs of V-Lab Math users.

Table 2. List of Needs Users

No.	List of Needs
1	V-Lab Math application is online
2	Applications can be accessed through computers, laptops, or gadgets
3	There are materials that students can easily learn.
4	Material presented with multimedia support to make it more interesting
5	There are pictures/photos of mathematical figures related to the material
6	There is a simulation feature to facilitate understanding
7	There is an evaluation feature to measure the results of the learning process by using the application
8	The problem in the evaluation feature in addition to being viewed directly, can also be downloaded

3. Ideate

This process is a depiction of the solution proposed by the designer to the user. This case describes the architecture of the application menu structure and mockup to make it easier to create online-based V-Lab Math application layouts. The mockup design image formed is consulted first with the user to get an agreement so that there are no significant changes when the application layout is built. Figure 2 show that an overview of the menu structure and mockup of the V-Lab Math app.

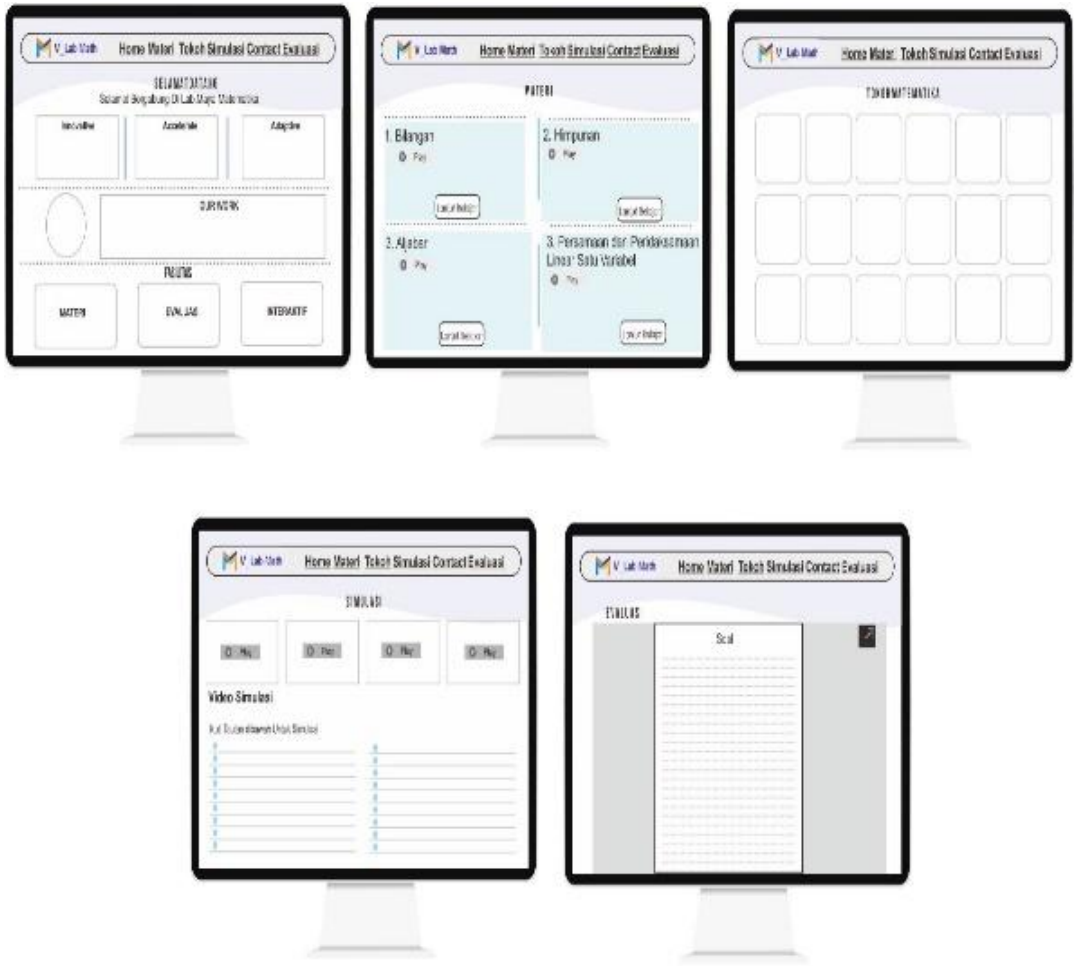

Figure 2. Mockup UI Design/UX V-Lab Math Application

The menu structure in the V-Lab Math application is as follows as Figure 3.

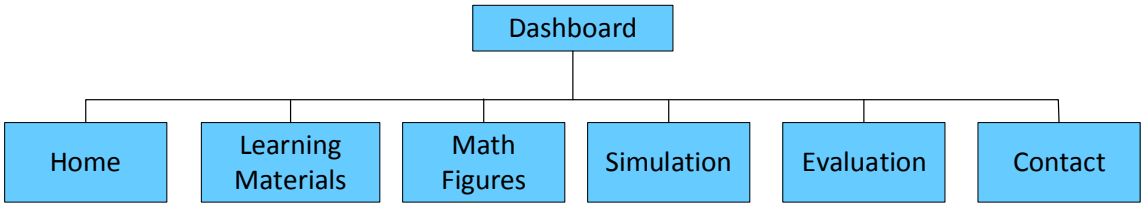

Figure 3. V-Lab Math Application Menu Structure

4. Prototype Process

This process is an implementation of the idea that has been obtained in the previous process into an application and product that is ready to be tested. In this stage,

produce the finished product and as many users of the application. Figure 4 show that an image of the product design that has been implemented.

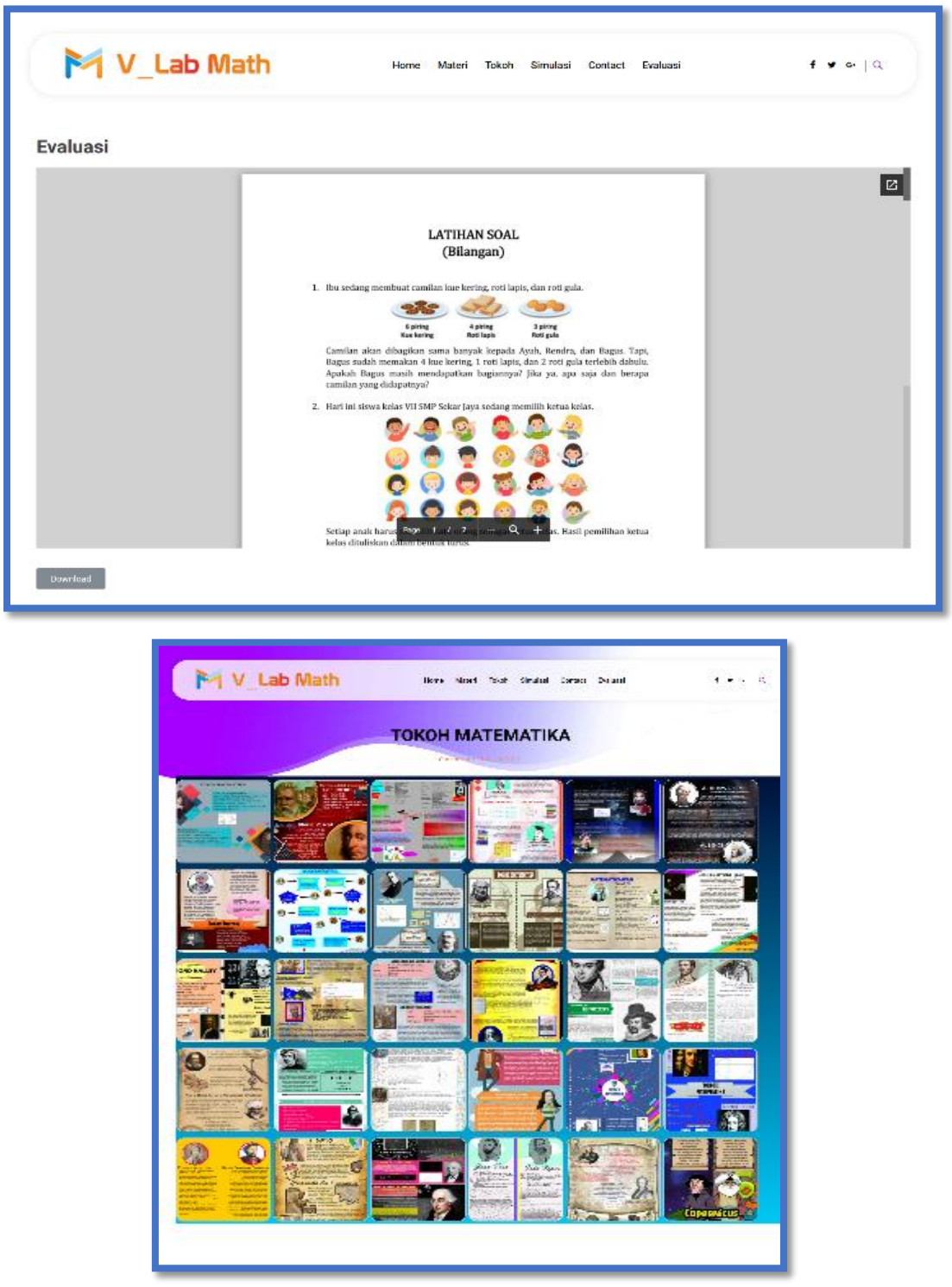

Figure 4. Design Results of Prototype UI /UX V-Lab Math

The use of the V-Lab Math application can be seen in Figure 5. The business process of using the application is depicted in the flowchart based on the menu options selected by the user.

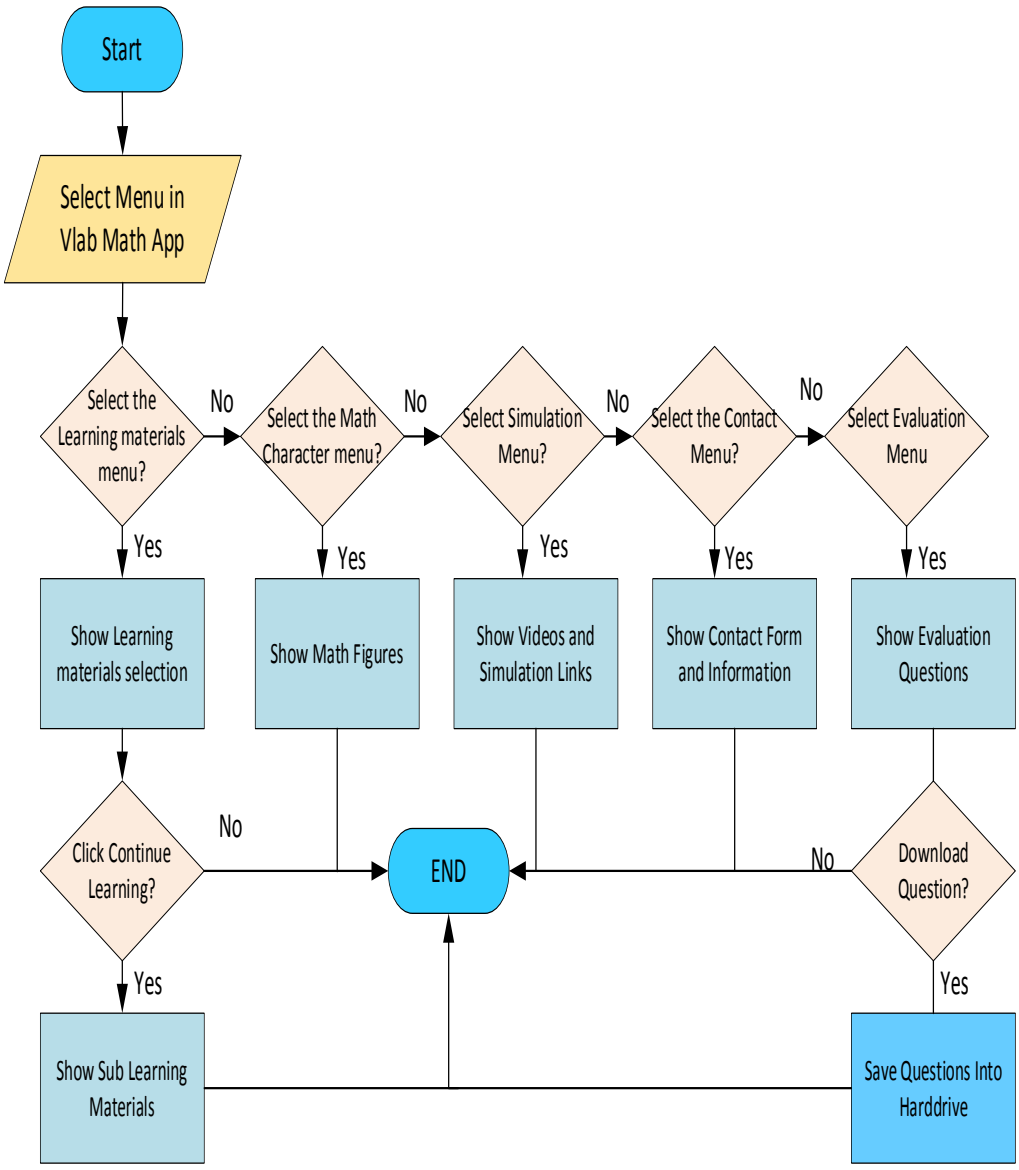

Figure 5. Scenario Use of V-Lab Math Application

5. Test

This process is a trial of the use of applications that have been developed. The evaluation was conducted by V-Lab Math users in this case, teachers and students

of SMP N 1 Pecalungan with black box test method as well as the measurement of effectiveness and ease.

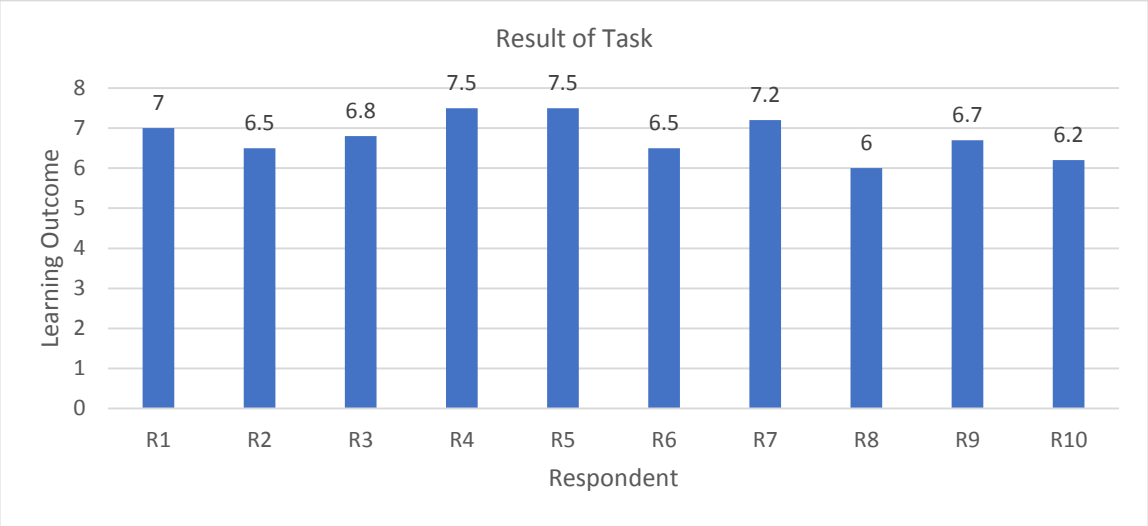

Figure 6. Respondents' Effectiveness Assessment Task Results

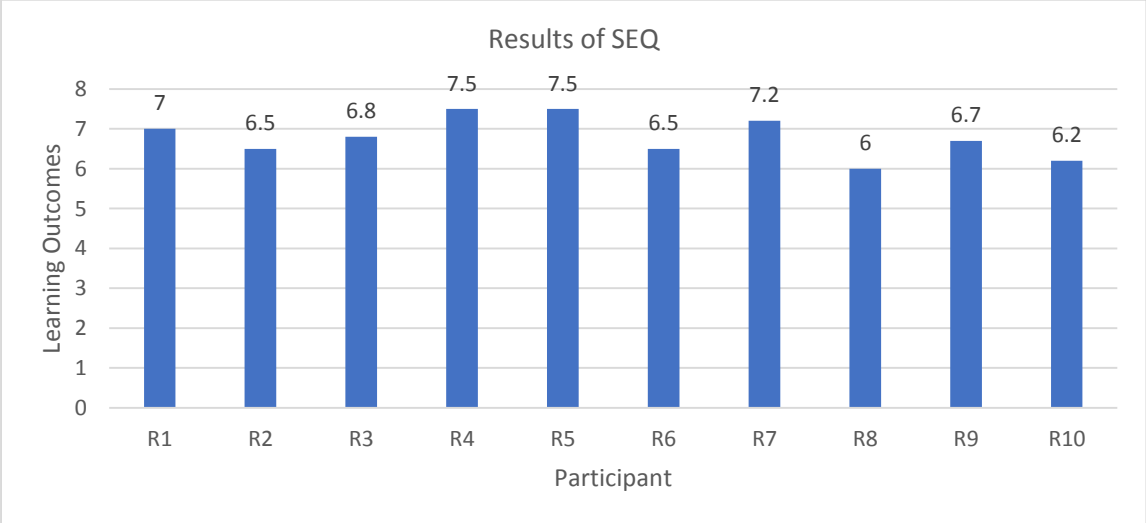

Figure 7. User SEQ Graphic

DISCUSSION

The steps in the design thinking method have been carried out starting from the empathize stage which is the stage to find out the needs of users in the application in this stage has been interviewed with question items presented at Table 1 and observations made at SMP N 1 Pecalungan Batang Regency. In addition, the Library

study related to research on UI/UX that has been done previously by [6][7][8][9], as well as research related to virtual laboratories that have been conducted by [10][11]. The define stage is done by writing the needs obtained from the interview results, the needs of the V-Lab Math application can be seen in Table 2; there are eight basic needs desired by V-Lab Math user users. The ideate stage formed a mockup layout of the V-Lab Math application presented in figure 2 with the concept of symmetrical balance, as well as the menu structure of the V-Lab math application presented in figure 3, among others, material, mathematical figures, simulations, evaluations, and contacts. The prototype stage is the stage of implementing the idea that has been obtained in the previous stage; in this stage there is a main menu display structure as presented in figure 4, among others: a) The Material Menu; in this menu the user will be provided 4 (four) types of material namely Numbers, Sets, Algebraic Forms and Equations and Linear Inequalities one Variable. For the Number menu will be displayed sub-material if the user clicks on the further learning button, While the sub-material on the number material included integer sub material (Comparing Integers, Integer Addition and Subtraction Operations, etc.) and Fractional Numbers (Comparing Fractional Numbers, Fractional Addition and Subtraction Operations, etc.), Largest and Smallest Federal Multiples. b) Character Menu, in this menu users will be able to see and study mathematical and theoretical figures found. Users can enlarge the image of the character by choosing one of the character images then do the left click then the image of the character will appear larger and information about the figure is more detailed. c) Simulation Menu, in this menu users can see the simulation videos that are presented in the application. In addition, users can choose a list link to simulate various materials related to numbers, sets, algebraic forms and equations & linear inequality of one variable. d) Contact menu, in this menu users can see contacts from V-Lab Math application developers. e) Evaluation Menu, in this menu the user will get a view of the evaluation question, the problem can be directly read or can also be downloaded if the user wants to save the problem into the user's hardrive/ storage media. The test stage is the final stage in the design thinking method in this stage obtained the results of testing with the system testing process carried out by conducting component testing, namely testing of system components. The components tested in this study were interface components. Component testing is done to find out the functionality of the interface that has been made whether it works as expected or not. From the results of testing interface components with the black box test method obtained 100% results so that it can be concluded that all the menu components and buttons in the application have pointed to the right page and have run according to its function. The effectiveness assessment results obtained an average of 93% when compared to branch mark 78% then this result is above standard. The results of the ease aspect assessment obtained an

average result of 6.7 when compared to branch mark 4.8 then it is above average and easy to use.

CONCLUSION

Application development using design thinking can be used for the creation of User Interface (interface) and User Experience (user experience design) designs that accommodate user needs. The application of methods ranging from emphasizing, defining, ideating, prototype, and Testing in case studies of UI /UX creation V-Lab Math application is beneficial for system developers to produce product prototypes that meet user expectations. The final product results of the prototype have passed the process of direct testing by the user, and system testing using component testing on the menu components has led to the right page, and testing on the application button has also run according to its function, and with single ease, questions obtained an average of 93% for effectiveness and 6.7 for the convenience aspect.

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