Usability testing of digital map application using hand gesture recognition as a historical learning media for elementary school

A C Padmasari1*, A H Hernawan2, D Rostika3 and Y Wahyuningsih3

1 Prodi Pendidikan Multimedia, Universitas Pendidikan Indonesia, Bandung, Indonesia
2 Teknologi Pendidikan, Universitas Pendidikan Indonesia, Bandung, Indonesia
3 Prodi Pendidikan Sekolah Dasar, Universitas Pendidikan Indonesia, Bandung, Indonesia

*ayungcandra@upi.edu

Abstract. The need for digital learning media is currently starting to increase, the use of conventional learning media has become less attractive to students of the current generation. Especially now, the need for digital learning media is starting to increase because the current generation of elementary school students is a generation that easily adapts to technology. Researchers have designed a digital map with a hand gesture recognition as a navigation control instead of a keyboard and mouse. After the application is made, the next step is validating user experience (UX) in the form of usability testing to see user responses. The questionnaire was distributed consisting of 13 questions which were grouped into 4 usability variables. This study involved 50 respondents of grade 4 elementary school students in 5 schools in the Cibiru hilir Bandung and using a linkert scale and get 4 usability variables with a percentage overall feasibility trial from elementary student are 79.25% and 72.5% from college student UPI Cibiru. Usability testing media consisting of learnability 80.5% with very good category, system performance is 75.2% with good category, memorability is 80.5%, with very good category, satisfaction is 83.3% with very good category.

1. Introduction

Education is a key factor in improving the quality of human resources. In essence, the teaching and learning process is the process of delivering messages or information from educators to students. Messages / information can be conveyed to students if students can capture and understand the contents of the message. But sometimes the message or information cannot be received properly due to certain factors so that tools or media are needed in delivering the message. In addition, the learning process can be successful if students are invited to involve all of their sense organs, because the more sensory tools used to receive and process messages, the more messages that can be understood and last a long time in the memory of students. The existence of today's computers has helped teachers in various interests related to their duties in designing, implementing and evaluating learning. Computers have been widely used in the teaching and learning process, with one goal that the quality of education going one step ahead with advances in technology [1]. The use of technology and communication in the field of education provides an opportunity for each lesson to access learning material that is presented in an interactive form via computer networks. At the global level, the development of ICT has influenced all
areas of human life. The instruction of ICT into other technological fields has gone so far, that not a single piece of technological innovation has not made use of ICT tools. Breakthroughs in research and innovation can increase industrial productivity and increase technology-based educational reforms. One of the important things in an effort to improve the quality of education is in the field of educational technology. AECT Task Force says educational technology is a complex and integrated process that involves many people, various procedures, ideas, tools and organizations, to analyze various problems and implement, evaluate, manage problem solving involving human learning activities [2]. One of the technological developments, namely multimedia, can change the way someone's learning is more interactive. Interactive multimedia (computer-based) is the relationship between humans (as users / product users) and computers (software / applications / products) in a certain file format. The multimedia system used in this study is a hand gesture-based digital map [3]. The Learning Process certainly requires some media in the form of both visual and audio media, with multimedia media collections packaged in one form; 2) user control, allows users to learn teaching material in accordance with their abilities and knowledge and can learn independently according to the material needed; 3) simulation and visualization, with animation technology, simulation and visualization of users can get more real information and abstract information. The new information is still in the form of something abstract, because it requires media that can help absorb the information; 4) different learning styles, multimedia has the ability to accommodate users with different learning styles [4]. Usability Testing is one way to find out whether the user can easily use the application, how efficient and effective Application can help the user achieve its goals and whether the user is satisfied with the application used. Usability is related to the quality of the user experience when using the application, whether it is a web-based, desktop-based, or mobile-based tool or application. Usability includes several factors, namely intuitive design, ease of learning, effective use, the level of easy to remember, the level of errors that occur, and the level of satisfaction which is subjective. Therefore, at the time of testing, the factors related to usability will be tested. The development of communication technology has made it possible for someone to be able to access content via internet wherever they are via smartphones. Most people today are active users of smart phone and get benefit from many applications that are built on software [5]. Meanwhile, according to ISO 9241-11 1998 usability is defined as the extent to which a product can be used by certain users based on its effectiveness, efficiency and satisfaction in the context of use in order to achieve specified goals. The trial content of this digital map design took the topic of social studies learning material on the historical site of West Java. The reason for taking this content is because it has found obstacles in learning including learning media still using rote learning styles, text-based, teacher-centered teaching methods without any technology-assisted modifications, so that students do not master the concepts being taught. As with the history material in social studies in elementary school grade 4 semester 1, there are quite a lot of two materials, namely 1) local historical heritage (around the regency and province) and its preservation efforts.

2. Methods
The research design is based on:

- Market / Costumers (Potential and problems needed / needs needed).
- Production (Producing Product Design).
- Design and Development (Design of development procedures).

The following is a description of the statement above, among others [6].
Based on figure 1, the results of the design are used as a learning modality that supports learning. According to the design, it is an expression of the design of the mind-brain system. Is the basic ability of individuals to acquire and create experiences [7]. Learning modalities are the various ways the brain-mind system accesses. Furthermore, we conducted trials with usability techniques, where this technique has three aspects, including effectiveness, efficiency, and user satisfaction [8]. As explained by Nielsen, an application is called usable if its functions can be executed effectively, efficiently and satisfactorily [7]. Furthermore, the three aspects of usability can be explained as follows [9]:

- **Effectiveness**, refers to the extent to which a product behaves in a way that users expect and the ease with which users can do what is desired.
- **Efficiency**, is the speed at which the user's goal can be achieved accurately and completely and is usually a measure of time.
- **Satisfaction** (satisfaction), refers to the user's perceptions, feelings, and opinions about the product. Typically, users are asked to rate and rate the products they have tried, and this can often reveal the cause and reason for the problem.
- **Error**: How many mistakes have been made by the user.
- **Memorability**: When Users Use media / applications, how much they remember (get used to) the user.

To overcome this problem, in this study an evaluation of the Digital Map Application in terms of usability will be carried out which aims to measure the effectiveness and efficiency of its use, and to determine the extent to which the application can provide satisfaction to the user as an alternative decision for the continuity of the application. Usability evaluation focuses on how well users can learn and use the product to achieve its goals and assess the extent to which interactive systems are easy and fun to use [10]. For this reason, the approach used in this research is usability testing. As new application, it is need to be tested for its usability before launch. Usability testing will show how easy user interfaces are to used. The objective of this research is to demonstrate the result of usability testing for application JST based on five characteristics: learnability, effectiveness, memorability, errors, and satisfaction [11]. Usability testing can use instruments that have been developed by experts and human computer interaction (HCI) communities. Some of the instruments are free of charge as long as the source is mentioned, but many have licenses, which means that if they are used the users have to pay to the owners [12]. Usability testing method is the best way to evaluate an application or a product by testing it directly based on the user experience [13]. The final result of the evaluation of the Digital Map Application is expected to provide a good level of usability and obtain recommendations for improvements in order to produce a better application. Furthermore, there are steps that need to be done in usability testing which consists of four steps, namely (1) identifying the test target; (2) create usability testing tasks; (3) perform usability testing; and (4) usability testing analysis [14]. Usability testing is a technique in usability evaluation that can be used to collect data. To collect data, task scenarios are needed to guide users in using the application, as well as an instrument to measure the level of
effectiveness and efficiency of using the application. Task scenarios are a collection of tasks that must be done by respondents when using the application [15]. The task scenario consists of 13 tasks which can be presented in Table 1 below.

Table 1. Assessment table.

| No | Indicator                                                                 | Evaluation |
|----|---------------------------------------------------------------------------|------------|
|    | Programming aspect                                                       |            |
| 1  | Media Easy to use                                                        | 4          |
| 2  | Easily select navigation buttons on digital maps                          | 3          |
| 3  | Easily select the site image menu each city                              | 2          |
| 4  | Navigation buttons for entry and exit are easy to use                     | 1          |
| 5  | Menu button works fine                                                    |            |
|    | Content Aspect                                                            |            |
| 6  | The language used is easy to understand                                  |            |
| 7  | The language used is interesting                                          |            |
| 8  | Easy to understand the content of material                                |            |
|    | Interface Aspect                                                         |            |
| 9  | The layout of text and image is well visible                              |            |
| 10 | Attractive appearance                                                     |            |
| 11 | The colours displayed are comfortable and unobtrusive                    |            |
| 12 | Text can be read easily                                                   |            |

The analysis of this research uses descriptive analysis that processes quantitatively and qualitatively. The explanation of the two data analyzes is as follows:

2.1. Quantitative data analysis

Analysis of quantitative data in this study was obtained through task scenarios and filling out questionnaires with a linkert scale model. Furthermore, the results contained in the task scenarios are then processed and used to analyze the effectiveness and efficiency of the application, while the results of filling out the linkert scale questionnaire are used to analyze the level of user satisfaction.

2.2. User satisfaction analysis

Analysis of the level of user satisfaction in usability testing is measured and analyzed using the SUS questionnaire that is distributed to the user after the user completes the task. The SUS questionnaire consists of 13 statements in which each statement uses a Likert scale. Likert scale is used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena [16]. The use of the Likert scale in this study uses five scales with the following conditions, namely 1 = Strongly Disagree (STS), 2 = Disagree (TS), 4 = Agree (S), and 4 = Strongly Agree (SS). Symbolized by a smiley meter image to help users express their satisfaction with the learning media application (See Figure 2).

Figure 2. Smiley meter used in the questionnaire.
3. Results and discussion

Hand gesture-based digital maps position themselves as interactive digital maps which are designed as information media that will later be tested in learning. Hand gesture-based digital maps are designed to have the following uniqueness: a) Contains information about historical sites in West Java. In this study, a sample of 11 cities were taken with imaginative display designs with an adventurous concept to choose cities in West Java. b) User-friendly and easy to use because it adapts from the window display. c) Regarding area mapping, site locations in 11 cities in West Java are designed in a neat arrangement based on categories and sub-categories. With this concept, it is expected to provide a more innovative appearance in promoting one of the advantages and local potentials of the West Java region. The illustration can be seen in figure 3.

![Image](3. Results and discussion)

Figure 3. Feasibility trial interactive media, digital map application in elementary school.

The initial view of the digital map application consists of:

- Each navigation button in the image is described as follows
- Browse Map button which contains the menu of exploring the city of West Java which is depicted in the form of a map sketch, each piece of the map sketch has the content of the material along with the site image according to its respective site
- The trial indicator button is a button that functions to display indicator information and media functions in learning, the trial indicator button is equipped with how to use learning, both for individuals and for use in class
- The UPI Cibiru profile button contains information and identity of the UPI Cibiru and the media design team

3.1. Feasibility trial

The research data collection technique used a questionnaire and documentation. In detail, the data collection techniques are described as follows Questionnaire Used to measure program indicators relating to material, display, and program. With this method, data collection can be done simultaneously with many respondents. The results of the feasibility test are calculated using a linkert scale with a weight of 4,3,2,1. The determination in the linkert scale score has a scale score of 4 for respondents who strongly agree, a score of 3 agrees, a score of 2 is sufficient, a score of 1 state disagree. The results of the data analysis are then described as tables 2 and 3 follows.

| School name       | Programming | Contents | UI  | Total |
|-------------------|-------------|----------|-----|-------|
| SDN Panyileukan   | 242         | 168      | 85  | 158   |
| SDN Cibiru 09     | 195         | 98       | 173 |       |
| SDN Mekar Biru    | 160         | 102      | 176 |       |
| SDN Cibiru 06     | 191         | 92       | 157 |       |
| LAB SCHOOL        | 189         | 106      | 169 |       |
| Total             | 903         | 483      | 833 | 2219  |
| Maximal score     | 1200        | 600      | 1000|       |
| Percentage (%)    | 75.25       | 80.5     | 83.3| 2800  |
Overall percentage = \( \frac{\text{the number of scores that can be}}{\text{the maximum number of scores}} \times 100\% \)

Overall percentage = \( \frac{2219}{2800} \times 100\% = 79.25\% \)

3.2. Eligibility data based on PGSD students at UPI Cibiru campus

| Table 3. Data on eligibility test based on students. |
|--------------------------------------------------|
| Programming content | UI | Total |
|---------------------|----|-------|
| Total               | 762| 378   | 626 | 1766 |
| Maximum score       | 1020| 510   | 850 | 2380 |
| Percentage (%)      | 74.70588 | 74.11765 | 81.81818 |

Overall percentage = \( \frac{\text{the number of scores that can be}}{\text{the maximum number of scores}} \times 100\% \)

Overall percentage = \( \frac{1766}{2380} \times 100\% = 74.20168 \% = 74.2\% \)

4. Conclusion

Conventional media in learning activities are slowly starting to shift and are less attractive to alpha generation students. This problem poses its own challenges to find innovative and modern designs and media as one of the solutions in facing the challenges of bad 21 needs. Hand gesture-based map design equipped with a leap motion controller sensor as a navigation control to replace the keyboard and mouse is an effort to create innovative media according to the needs of the times. In theory, the interaction and communication between humans and machines through the use of gestures can be one way to increase comfort in the interaction process between humans and machines, especially if the interaction model presented is based on 3-dimensional space.

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