Evaluation of UI/UX Usability in Augmented Reality Application of Balinese Shadow Puppet *Panca Pandawa*

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Abstract. Augmented Reality (AR) *Panca Pandawa* Balinese Shadow Puppet is a digital educational application that aims to provide education and a detailed introduction to Balinese Shadow Puppet by displaying three-dimensional (3D) shapes of *Panca Pandawa*, namely: Yudistira, Bima, Arjuna, Nakula and Sahadewa. The aim of this study is to evaluate the user's experience when using the application of AR *Panca Pandawa* Balinese Shadow Puppet. In this study, the usability evaluation process for the application was carried out by implementing the heuristic evaluation method. This study uses Jacob Nielsen's 10 usability heuristics for user interface design guidelines. The results of this study are as follows: there are 6 usability problems in the application interface of AR *Panca Pandawa* Balinese Shadow Puppet. Based on the heuristic aspect, there are 2 problems in the aspect of Visibility of System, there are 2 problems in the aspect of User Control and Freedom, there is 1 problem in the aspect of Flexibility and Efficiency of Use, and there is 1 problem in the aspect of Aesthetic and Minimalist Design. The research findings show that usability evaluation using the heuristic evaluation method can be used as a reference and material for improving the interface of AR *Panca Pandawa* Balinese Shadow Puppet.

Keywords: Usability Evaluation, Heuristic Evaluation Method, Augmented Reality, Balinese Shadow Puppet, *Panca Pandawa*.

1 Introduction

Augmented reality is a technology that combines real and virtual objects in a real environment [1]. Augmented reality applications are also part of interactive multimedia which consists of many components or media that are integrated with each other, which are able to interact with their users [2]. Riccardo Palmarini in his 2018 research stated that AR technology with its uses can be applied to various fields; tourism, entertainment, marketing, operations, logistics, manufacturing, maintenance, education, and other fields [3]. In full it was also conveyed by E.Z. Barsom in his research in 2016 he stated that AR technology is able to support various activities with a certain level of specifications such as validly supporting the training of medical professionals [4]. AR technology can interact well with users, if the application's user interface can make it

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easier for users to use the application. Detailed testing is needed to find out if the user interface of an application is working properly, which can be tested through a usability heuristic process using the heuristic evaluation method. The heuristic evaluation method can be used as a testing method to determine the user's experience when using the application [5] especially applications that utilize augmented reality technology.

In this study, the application that was tested was the AR Panca Pandawa Balinese Shadow Puppet. An AR application which is the result of creativity combined with elements of Balinese shadow puppet performance, which is played by a dalang (puppeteer) who is also the narrator of the dialogue of the shadow puppet characters, accompanied by Balinese gamelan music. Conceptually, Balinese shadow puppets have their own form and presentation when compared to puppets in other regions [6]. In general, Balinese shadow puppet performances can only be witnessed at certain activities or events, such as at religious ceremonies, festivals and activities related to traditional Balinese culture.

The application of AR Panca Pandawa Balinese Shadow Puppet is able to provide a new experience to users in learning various information about the details of Balinese shadow puppets, especially the Mahabharata puppet characters with Panca Pandawa characters in the form of three-dimensional (3D) objects displayed on mobile devices/smartphones. In the application there are 5 menus that have their respective functions, including; 1. "Tentang" menu to display information about application details, 2. “Penggunaan” menu to display the steps in using the application, 3. "Pindai Marker" menu to display three-dimensional (3D) objects of the Panca Pandawa Balinese Shadow Puppet, 4. "Video Aplikasi" menu to display videos of making Balinese Shadow Puppets, and 5. "Keluar Aplikasi” menu which can be used to exit the application. The menus in the AR application have their respective functions and uses which can be measured through the usability evaluation process with the heuristic evaluation method using Jacob Nielsen's 10 usability heuristics for user interface design guidelines.

The usability evaluation in this panel focuses on testing the application's user interface which aims to determine the user's experience when using the AR Panca Pandawa Balinese Shadow Puppet.

Through usability evaluation using the heuristic evaluation method, it is hoped that it can provide results that can be used as references and material for improving the interface of the AR *Panca Pandawa* Balinese Shadow Puppet, as well as implications for disseminating knowledge that can be used to evaluate user experience, in order to provide better application performance and usability.

2 Method

This research method focuses on evaluating the usability of the AR *Panca Pandawa* Balinese Shadow Puppet, the importance of usability shows that usability evaluation is an important process in the development stage to produce a system or application that is better than before [7]. The research method used to evaluate the usability of the AR *Panca Pandawa* Balinese Shadow Puppet utilizes the heuristic evaluation method.

Heuristic evaluation allows finding more usability problems than other evaluation methods [8].

2.1 Data Collection

The evaluation of usability in the AR *Panca Pandawa* Balinese Shadow Puppet uses the heuristic evaluation method. The details of the activities carried out are as follows:

Preparation. At this stage, the principles to be used are 10 usability heuristics for user interface design by Neilsen [9]. These principles include:

Visibility of System Status. The system should always keep the user informed about what is going on with feedback.

Match Between System and The Real Word. The system should speak the user's language, with words, phrases, and concepts that are familiar to the user rather than system-oriented language.

User Control and Freedom. Users sometimes select system functions by accident and will need a clear "emergency exit" sign to leave an unwanted situation without having to go through lengthy dialogs.

Consistency and Standards. Users should never have to ask whether different words, situations, or actions mean the same thing.

Error Prevention. Careful design to prevent a problem from occurring in the first place is better than a good error message. Either eliminating error-prone conditions or checking for errors and displaying them to the user.

Recognition Rather Than Recall. Minimize user memory usage by making objects, actions, and options visible. Users are not supposed to memorize information from one part of the dialog to another.

Flexibility and Efficiency of Use. Accelerators, invisible to novice users, may often speed up interactions for expert users so that the system can serve both experienced and inexperienced users.

Aesthetic and Minimalist Design. Dialogues should not contain information that is irrelevant or rarely used. Each additional bit of information in the dialogue competes with the relevant information units and reduces their relative visibility.

Help Users Recognize, Diagnose, and Recover from Errors. Error messages should be displayed in plain language (no code), precisely indicate the problem, and provide a constructive solution.

Help and Documentation. While it is better if the system can be used without documentation, it may be important to provide help and documentation. Any information should be easy to find.

Pre-Evaluation. Pre-evaluation will be carried out regarding the AR *Panca Pandawa* Balinese Shadow Puppet and heuristic evaluation. After that, a heuristic evaluation simulation will be given, by providing an example of an interface display.

Evaluation. The evaluation stage will be carried out by evaluating the appearance of the application's user interface in accordance with predetermined principles. If there is a usability problem due to a violation of the principles, then the problem will be recorded.

Rating. Problems obtained in the previous stage will be given a severity rating. The severity of each problem is measured based on 3 factors, as described by Nielsen, namely the frequency of the problem, its potential impact on users, and its persistence. The five severity rating values for usability problems by Nielsen [10] can be seen in Table 1.

Table 1. Severity Rating

Rating	Information
0	Disagree that this problem is a usability issue.
1	Cosmetic problems only; the problem can be fixed if there is additional time.
2	Minor usability problems; low priority issues that need to be fixed.
3	Major usability problems; issues with high priority to be fixed.
4	Usability disaster; it is very important that the problem is fixed before the product is released.

Post Evaluation. Findings will be combined and will be eliminated if there are duplicate problems. This stage will produce a heuristic evaluation report.

2.2 Data processing

The data obtained in the previous step will be processed by summarizing the evaluation results into a table containing the principal aspects and the number of problems they have.

3 Results and Discussion

3.1 Results

Usability evaluation is done by evaluating the application interface based on predetermined principles. Based on the evaluation carried out, there are 6 usability problems in

the AR *Panca Pandawa* Balinese Shadow Puppet application interface. The mapping of the problem findings is divided into two categories, namely based on the heuristic aspect, and based on the severity rating. Detailed findings based on heuristic aspects can be seen in Table 2.

Table 2. Heuristic Aspect Findings

No	Code of Principles	Principle Name	Number of Problems Found
1	H1	Visibility of System Status	2
2	H2	Match Between System and The Real World	0
3	H3	User Control and Freedom	2
4	H4	Consistency and Standards	0
5	H5	Error Prevention	0
6	H6	Recognition Rather Than Recall	0
7	H7	Flexibility and Efficiency of Use	1
8	H8	Aesthetic and Minimalist Design	1
9	H9	Help Users Recognize, Diagnose, and Recover from Errors	0
10	H10	Help and Documentation	0

Based on Table 2, it can be seen that not all heuristic aspects have problem findings. Of the 6 findings on the heuristic aspect, there are 2 problems on the Visibility of System aspect, there are 2 problems on the User Control and Freedom aspect, there is 1 problem on the Flexibility and Efficiency of Use aspect, and there is 1 problem on the Aesthetic and Minimalist Design aspect. Detailed findings based on severity rating can be seen in Table 3.

Table 3. Severity Rating Findings

No.	Severity Rating	Number of Problems Found
1	0	0
2	1	4
3	2	2
4	3	0
5	4	0

Based on Table 3, it can be seen that not all severity ratings have problem findings. A severity rating with a value of 0 has 0 findings, a severity rating of 1 is the most common finding, which has 4 findings, a severity rating of 2 has 2 findings, and a severity rating of 3 and 4 both has 0 findings.

3.2 Discussion

Usability evaluation is done by evaluating the application interface based on predetermined principles. Based on the evaluation carried out, there are 6 usability problems in the AR Panca Pandawa Balinese Shadow Puppet application interface.

Based on the findings of the heuristic aspects, it can be seen that not all heuristic aspects have problem findings. Of the 6 findings on the heuristic aspect, there are 2 problems on the Visibility of System aspect, there are 2 problems on the User Control and Freedom aspect, there is 1 problem on the Flexibility and Efficiency of Use aspect, and there is 1 problem on the Aesthetic and Minimalist Design aspect.

Based on the findings of the severity rating, it can be seen that not all severity ratings have problem findings. A severity rating with a value of 0 has 0 findings, a severity rating of 1 is the most common finding, which has 4 findings, a severity rating of 2 has 2 findings, and a severity rating of 3 and 4 both has 0 findings.

The results that have been obtained based on usability evaluation using the heuristic evaluation method and severity rating shows that the AR Panca Pandawa Balinese Shadow Puppet has found problems with the user interface with 4 cosmetic problems only; problems can be fixed if there is additional time, and 2 findings of minor usability problems; problems with low priority that need to be repaired, or in other words the user interface of the AR *Panca Pandawa* Balinese Shadow Puppet has predominantly fulfilled Nielsen's 10 usability heuristics standards for user interface design.

4 Conclusion

The results of evaluating the usability of the user interface of the AR *Panca Pandawa* Balinese Shadow Puppet using the heuristic evaluation method has found several usability problems in the application user interface. There are a total of 6 problem findings, which uses Neilsen's 10 usability heuristic principles for user interface design. There are 2 problems in the Visibility of System aspect, there are 2 problems in the User Control and Freedom aspect, there is 1 problem in the Flexibility and Efficiency of Use aspect, and there is 1 problem in the Aesthetic and Minimalist Design aspect.

Based on severity rating, not all severity ratings have problem findings. A severity rating with a value of 0 has 0 findings, a severity rating of 1 is the most common finding, which has 4 findings, a severity rating of 2 has 2 findings, and a severity rating of 3 and 4 both has 0 findings.

Evaluation of usability using the heuristic evaluation method and severity rating shows that the AR Panca Pandawa Balinese Shadow Puppet has problem findings in the user interface with 4 findings of cosmetic problems only; problems can be fixed if there is additional time, and 2 findings of minor usability problems; problems with low priority that need to be repaired, or in other words the user interface of the AR *Panca Pandawa* Balinese Shadow Puppet has predominantly fulfilled Nielsen's 10 usability heuristics standards for user interface design.

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