

DEVELOPMENT OF BALINESE PUPPET EDUCATIONAL GAME AND USABILITY TESTING USING SUS, UMUX, AND UMUX LITE

DESENVOLVIMENTO DE JOGO EDUCACIONAL DE FANTOCHES BALINESES E TESTES DE USABILIDADE USANDO SUS, UMUX, E UMUX LITE

Agus Aan Jiwa Permana

Universitas Pendidikan Ganesha, Indonesia
agus.aan@undiksha.ac.id

Komang Setemen

Universitas Pendidikan Ganesha, Indonesia
k.setemen@undiksha.ac.id

I Gede Made Surya Bumi Pracasitaram

Universitas Pendidikan Ganesha, Indonesia
ipracasitaram@undiksha.ac.id

ABSTRACT

This research is the development of interactive learning media in the form of learning games. With the cultural crisis among children, an idea was raised about introducing Balinese shadow puppets (wayang kulit Bali) with puzzle techniques and counting skills, in line with the decreasing interest in shadow puppetry among teenagers and children. This media was developed using articulate storyline 3, which is very important to develop for grade 1 elementary school children in cultural introduction subjects. This research aims to produce interactive learning media to introduce Balinese shadow puppets using puzzle techniques. This research method is MDLC (Multimedia Development Life Cycle). This research was carried out through 6 main stages: Concept, Material Collection, Manufacturing, Testing, and Distribution. Research to determine the conditions that occur or prove the truth of a research design being carried out. Based on the learning media system development with the method, the result shows that the learning media developed is suitable for introducing Balinese shadow puppets using puzzle techniques through white box testing using the black box testing method. The results of the implementation have also been tested in beta version at SD Negeri 1 Kaliuntu in Singaraja, to introduce the product and at the same time give children the opportunity to try playing with the teacher. The UX testing method uses three methods, namely SUS, UMUX, and UMUX Lite, which produce suitable ranges.

Keywords: Puppet, Educational Games, Puzzle Games, Indonesian culture.

RESUMO

Esta pesquisa é o desenvolvimento de mídias de aprendizagem interativas na forma de jogos de aprendizagem. Vendo a situação da crise cultural entre as crianças, surgiu a ideia de introduzir o wayang kulit balinês com técnicas de quebra-cabeças e habilidades de contagem. Com a diminuição do interesse pelos bonecos de sombra entre adolescentes e crianças. Esta mídia foi desenvolvida usando o enredo articulado 3, que é muito importante para ser desenvolvido para crianças do 1º ano do ensino fundamental em disciplinas de introdução cultural. Esta pesquisa tem como objetivo produzir meios de aprendizagem interativos para a introdução do wayang kulit balinês usando técnicas de quebra-cabeças. Este método de pesquisa é MDLC (Multimedia Development Life Cycle). Esta pesquisa foi realizada através de 6 etapas principais, nomeadamente Conceito, Coleta de Materiais, Fabricação, Testes e Distribuição. Pesquisa para determinar as condições que ocorrem ou provar a veracidade de um projeto de pesquisa que está sendo realizado. Com base nos resultados do desenvolvimento do sistema de mídia de aprendizagem deste método, a mídia de aprendizagem desenvolvida é adequada para uso no processo de introdução de fantoches de sombra balineses usando técnicas de quebra-cabeça por meio de teste de caixa branca usando o método de teste de caixa preta. Os resultados da implementação também foram testados em versão beta no SD Negeri 1 Kaliuntu em Singaraja, para apresentar o produto e ao mesmo tempo dar às crianças a oportunidade de experimentar brincar com o professor. O método de teste UX usa três métodos, nomeadamente SUS, UMUX e UMUX Lite, que produzem bons intervalos.

Palavras-chave: Fantoches, Jogos Educativos, Jogos de quebra-cabeça, Cultura indonésia.

Introduction

Balinese shadow puppet performances, as an artistic creativity, can provide enjoyment, beauty, and pleasure for the audience. As cultural creativity, Balinese shadow puppet performances can be used as a source of ideas, ideology, and behavioral guidelines, which originates from the teachings of the Hindu Krishna religion; Suadnyana (2020). Spiritual and entertainment themes are two types of themes from Balinese shadow puppets. Shadow puppets with a spiritual theme usually appear at Hindu entertainment and religious events to complement the ceremony. The shadow puppets will be used with an entertainment theme at public parties related to social issues because they have a contemporary storyline and might provide a storyline affected by modernization.

In the new era, society must develop and preserve heritage because Western culture has become the daily consumption of young people. The impact of this culture will be threatened and considered ancient, making it difficult for young people to recognize their own culture, even leading to their not recognizing it.

The author was inspired to develop a similar game based on observations of the GatchaLife game with cartoon characters that children widely access. This game is a massive influence because it is not about not being interested in the culture but how to adapt to current conditions so that local culture does not seem dull. Therefore, culture must be able to adapt and keep up with the times. It means that with the advent of the technological era, culture itself must be able to be packaged by introducing shadow puppets in the form of games so that they are not easily forgotten. The author learns to understand the existing situation and then plans to provide an innovative effort to preserve local culture to make it still exist through the Balinese shadow puppet learning game by following modernization.

Games are very popular with children, teenagers, and even adults. The game developed uses a puzzle concept, a picture arranging game. In this game, the user is asked to train the memory of a picture shape and then rearrange it correctly, and after the picture is correct, the name of the Wayang character in question will appear. Based on search results in the mass media, puzzles, also known as picture puzzles, achieved the record for the most significant model game in 2014. The puzzle concept used in this game is guessing the Balinese version of the Ramayana wayang characters and counting games.

The users of this application are grade 1 elementary school children in cultural introduction lessons. Teachers at school can direct children using this game to explain the lesson. This game can also be run directly on laptops and Android mobiles, making product testing easier. Wayang (puppets), packaged in the Wayang Educational Game, is a concept relevant to current reality. The advantage of using this technique is that students can learn more fun and meaningfully. The puzzle technique is a disassembled image related to concepts. The advantage is that students thoroughly solve problems using patchwork and do not get bored quickly. The diversity of students can also influence learning achievement. For example, learning activities and memory abilities. Memory ability is the ability to retrieve, store, and recall information or experience when needed Indahwati (2012).

In the product user experience (UX) testing process, this research uses three questionnaires, namely the System Usability Scale (SUS), UMUX, and UMUX-Lite, to

provide various assessments and responses from users because all the question items in the questionnaire sometimes confuse users when filling out. The testing process in actual conditions aims to find out whether the product produced can be accepted according to the user's wishes, such as when conducting observations, interviews, and digital literacy, which discusses the concept of games, educational games, and puppets to produce a simple product to help teachers in schools in order to maintain the existence of Indonesian national culture and Balinese culture specifically.

Material and method

This chapter will discuss several aspects of review literacy related to the research being carried out. Nobody is perfect; this research is new and based on an idea from the author, so the matters related to this research are dichotomous and will be combined to perfect this research theoretically.

- **History of *Wayang* (Shadow Puppets)**

The art of Balinese shadow puppets, one of which is the archipelago's cultural heritage, has quite a long civilization and history, so the form of Balinese shadow puppet art today is different from that of other regions. Therefore, the existence of Balinese shadow puppets should be inherited and preserved until today. They represent human lives and convey religious teachings through the movements and actions of the figures in them as characters of human life I Gede Sutana (2020).

Shadow puppetry is a type of performing art developed in Bali and parts of Java. Puppets in Indonesian Hindu Art and Culture tell a story about characters from the epics Ramayana and Mahabharata, played by a puppeteer in a performance that essentially contains an educational message. In its development, historical sources include historical stories, legends or myths, and Indonesian cultural treasures, especially in Java and Bali Witari (2016).

Shadow puppet performances from the Ramayana epic are usually at night, with colorful lights and blencong (Javanese Oil Lamp) accompanying the gamelan (Traditional instruments). The Ramayana puppet is often performed as a secular

entertainer. In its performance, the Ramayana puppet theater displays several characters in a story originating from Kiskenda Kanda to Uttara Kanda Dewi et al. (2019 e Permana et al. (2020).

1. Sri Rama

Rama is often also known as Ramawijaya. He came from the kingdom of Ayodhya, the son of Prabu Dasarata (Raja) and Dewi Raghu, grandson of Prabu Banaputra. Because of his intelligence, magic, and ingenuity, Sri Rama was blessed to incarnate into the world with illustrations in Balinese wayang, like Figure 1.

Figure 1 – Rama puppet



Source: <https://www.murnis.com/shop/shadow-puppets/wayang-kulit-balinese/wayang-kulit-rama-2/>

Figure 2. Dewi Sintha puppet

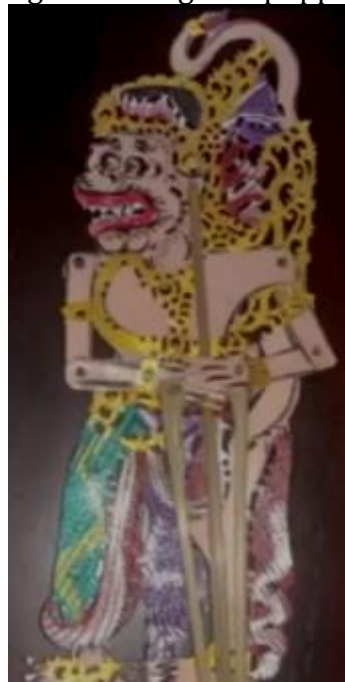


Source: <https://www.murnis.com/shop/shadow-puppets/wayang-kulit-balinese/wayang-kulit-sita-2/>

2. Dewi Sintha

Dewi Sintha is loyal and devoted to her husband. This character is shown when Ravana kidnaps Dewi Shinta, and she manages to maintain her chastity. When Sri Rama tested her purity by burning her, Sita survived the flames. Illustration of Dewi Sintha as in Figure 2.

Figure 3 – Sugriwa puppet



Source : Bratanatyam (2017).

3. Sugriwa

Sugriwa is the protagonist in the epic Ramayana. He is the monkey king and a vanara. He lives in the Kiskenda Kingdom with his brother, Subali. Sugriwa, also known as Sri Rama's friend, helped him fight Ravana to save Sita. The name Sugriwa in Sanskrit (Sugrīva) means "beautiful ancient". Sugriwa's illustration is like Figure 3.

Figure 4 – Subali puppet



Source: <https://www.roots.gov.sg/Collection-Landing/listing/1113931>)

4. Subali

Subali is the king of Wanara in the Ramayana epic. He was the brother of Sugriva, Sri Rama's ally. When an argument broke out between the two Wanara brothers, Rama sided with Sugriwa. Subali finally died at the hands of the prince of Ayodhya. A detailed image of Subali can be seen in Figure 4.

5. Jatayu

Jatayu is Aruna's son and Garuda's grandson. He is Sempati's brother. Jatayu is the bird who saw Dewi Sita kidnapped by Rawana. This character fights but loses and ultimately dies. Figure 5 illustrates Jatayu in a Balinese shadow puppet.

Figure 5 – Jatayu



Source : <https://www.roots.gov.sg/Collection-Landing/listing/1110180>

- **Theories and Concepts of Educational Games in Learning and Their Influence on Children.**

The game is fun and has easy and increasingly difficult levels. Games are now widely applied in school learning, such as research by Yasa et al. (2022), who developed a volleyball game that received a positive response from users for sports subjects. This game complements the blended learning implemented by the teacher so that before trying it directly, students already know the simulation and rules by playing the game.

Figure 6 – MDLC stages



Source: Metafora (2023)

Learning media is a way for teachers to arouse enthusiasm for learning in children and overcome boredom with learning by giving speeches in front of the

class. With the media, what the teacher conveys will become more authentic and enter the students' subconscious mind so they are interested in trying it Azizah; Humaisy (2020 e Fatihah; Ruhiat (2023 e Hendrayati; Pamungkas (2016 e Indarto (2019 e Komang; Yanti (2021 e Nurhadi (2020 e Reza, Noor Ellyawati (2021 e Setiawan et al. (2018 e Tambunan, N., & Siagian (2020)

- **MDLC (Media Development Life Cycle)**

MDLC (Media Development Life Cycle) methodology is the proper method for designing and developing media applications that are a combination of images, audio, video, animation, and other media Wibowo Kom et al. (2021 e Wibowo; Manelsi (2022). The development of this multimedia methodology is based on six stages: concept, design, material collection, assembly, testing, and distribution Kumala et al. (2021 e Reza, Noor Ellyawati (2021 e Sholihah; Agustina (2019 e Warnilah (2018). Even though it has the same development roots as the Software Development Life Cycle (SDLC), MDLC has unique characteristics regarding the development and use of multimedia elements (Roedavan et al. (2022)). The MDLC is as in Figure 6.

- **System Usability Scale (SUS)**

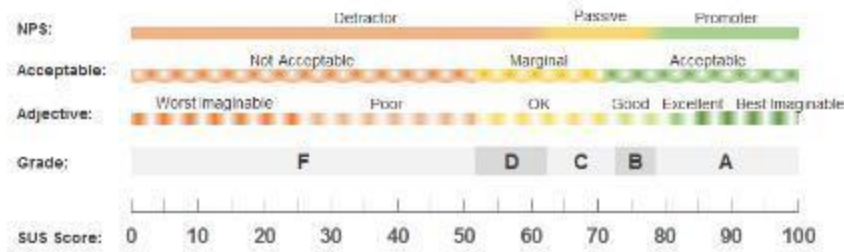
The SUS questionnaire is a standard for measuring software. SUS score is an industry-standard metric for measuring web and other products such as games Betteridge (2021 e Permana et al. (2021). The usability measurement process includes three words: effectiveness, efficiency, and customer satisfaction. This method can be used to carry out testing technology that is independent. The calculation process in the SUS method is as in equation 1. After getting the SUS score, look at the range of score values in Figure 7.

$$\text{Score} = \sum_1^{10} [(odd_{number} - 1) + (5 - even_{number})]$$

$$\text{SUS Score} = \text{Average (Score)}$$

(1)

Figure 7 – SUS range



Source : Sauro (2016).

- **UMUX dan UMUX Lite**

With so many SUS questions, Finstad (2010) tried to develop a simpler assessment. The 10-question-item scale was converted into 4-question items based on ISO 9241-11. This development indicates that the two scales are well correlated and reliable, aligning with one underlying usability factor. Additionally, perceived benefit metrics based on user experience are more concise. This assessment works well as a user experience module in product trials. The UMUX score is weighted with 4 question items and uses a 7-point Likert scale. To calculate the score for each question item, see Equation 2 (Inayah et al. (2024)). After getting the UMUX score, please check the score range as in Figure 8.

$$\text{Score} = \frac{1}{24} * \sum_1^4 [(odd_{number} - 1) + (7 - even_{number})] * 100$$

$$\text{UMUX Score} = \text{Average (Score)}$$

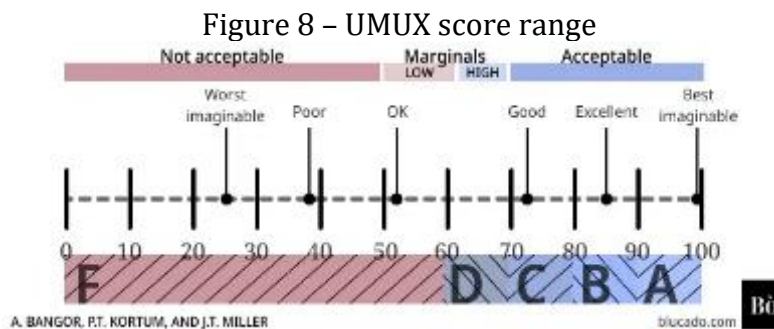
(2)

After the UMUX version appeared, research for product testing continued to develop, such as this Lite version of the UMUX method. UMUX Lite is a 2-item question from MUX for product benefit and user experience metrics, including "The ability of this system to meet my requirements" and "This system is easy to use". The estimated reliability of this questionnaire is 0.82 and 0.83 – very good for the two-item instrument. This questionnaire has a significant correlation with SUS (0.81, 0.81), where the score is sensitive to the respondent's assessment (Lewis et al. (2013)) frequency of use. Mean UMUX-LITE scores were slightly lower than SUS but were easily adjusted using linear regression to match SUS scores. The formula

used in UMUX-LITE is like equation 3. After getting the score, please check the range in Figure 8.

$$\text{Score} = \frac{1}{12} * \sum_1^2 [(Score Respon. - 1)] * 100$$

$$\text{UMUX-LITE Score} = 0.65 * (\text{Score}) + 22.9 \tag{3}$$



Source: Mellisourgos (2023).

Result and analysis

This research explains the data collection process, game scenarios, and product testing. This research has several types of data and sources of data as the basis for the research that has been collected. The data obtained includes primary data and secondary data. The main data are the results of interviews with elementary school teachers about the curriculum in introducing Indonesian culture in schools (grades 1-6). Secondary data is data obtained through journals and articles on the Internet (Dewi et al. (2019 e Permana et al. (2020)).

Figure 9 (a-d) – Game Testing Process in Real/School Environments

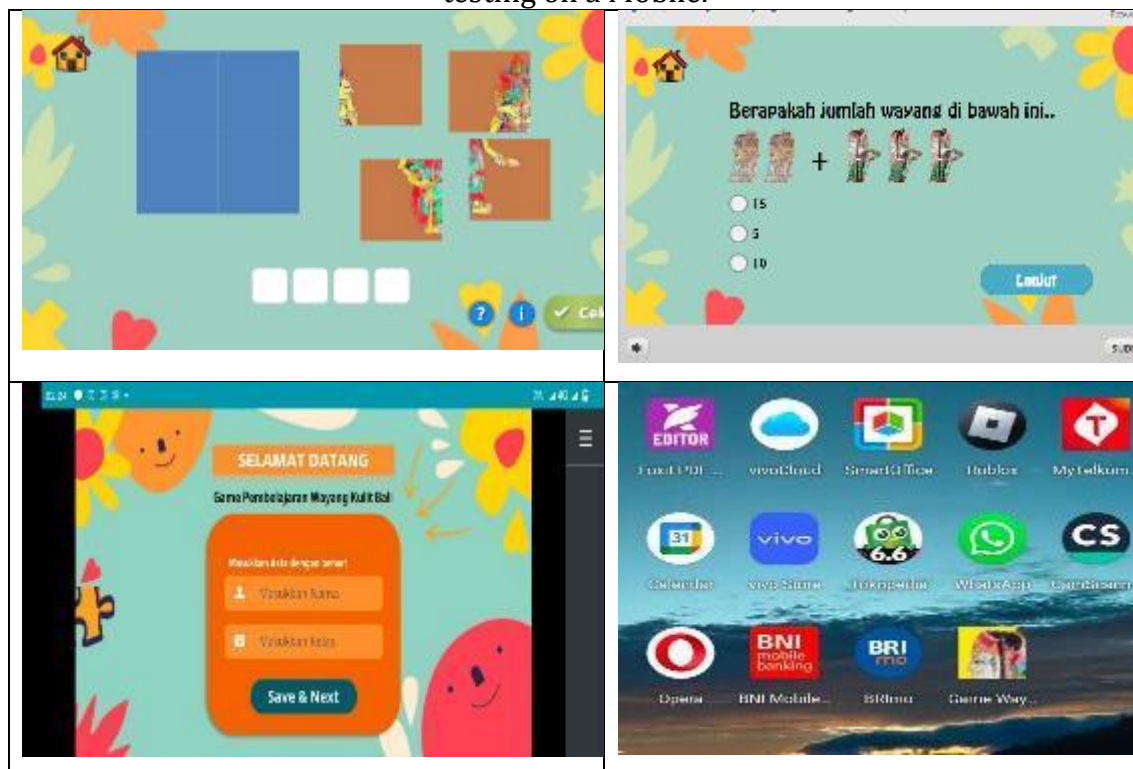


The next process is the development of a storyboard-based scenario, which contains pictures of the main page, instructions, and how to play the game; the type of game is puzzle and counting. During implementation, the author prepared puppet images, back sound music, and a template for this game. In the implementation process, the articulate storyline application version 3 was used.

Table 1 – Omparison of Questionnaire Results in Game UX Testing

SUS Questionnaire	UMUX Questionnaire	UMUX-LITE Questionnaire
1. I think I will use this game 2. I find this game difficult to use 3. I find this game easy to use 4. I need help from other people or technicians in using this game 5. I feel that the features of this game work as they should 6. I feel many things are inconsistent (not suitable for this game) 7. I feel like others will understand how to use this game quickly 8. I find this game confusing 9. I feel there are no obstacles in using this game 10. I need to get used to it first before using this game	1. Game capabilities meet my requirements 2. Using this game is a frustrating experience 3. This game is easy to use 4. I had to spend too much time to understand this game	1. The capabilities of this game application meet my needs as a teacher/student 2. This game is easy to use
Percentage Score: 75.66 %	85%	86%

Figure 10 - 2 The top images are testing on a Laptop, 2 The bottom Images are testing on a Mobile.



After the application was developed, testing was carried out in the form of alpha testing first before being tested in actual conditions at school. Alpha testing used the white box method to test product performance and the black box to test

the suitability of product input and output. UX testing was carried out at Kaliuntu 1 elementary school, involving 34 people, including 9 teachers and 25 students, as seen in Figure 9.

The game has been implemented based on the storyboard design. The game sound appears with standard settings so the end user can test it. As in Table 1, questionnaire questions are used in conducting trials 1.

Discussion and conclusion

Based on Figure 10, the results obtained are game displays on computers, laptops, tablets, and smartphones. Applications developed with AS3 can run on several media as expected. Game development using the MDLC method has been proven to run well at each stage, so users feel satisfied with the results, as evidenced by the questionnaire in Table 1. Testing with the SUS questionnaire produces good scores, while testing with UMUX and UMUX-LITE produces scores in a Very good range. The game's appearance on the hardware also meets expectations and runs well in Android *APK format. In puzzle games, if the user arranges the images correctly, the name of the puppet character will appear. Meanwhile, basic operations are displayed in counting games, namely addition and subtraction. If correct, then the user can move to the next level.

Based on the problems in schools, this educational game can be used as a medium to introduce characters from the Ramayana wayang. The choice of shadow puppets is because Balinese shadow puppets are one of the assets of the Indonesian nation. With the Gatcha Life game idea, this puppet game product emerged with puzzle techniques and basic arithmetic, including addition and subtraction. This game offers a different learning atmosphere to arouse students' feelings and reduce boredom. Making a Balinese shadow puppet learning game using the puzzle game technique using the MDLC method.

The game was developed with images, sound, and video combinations. Development was carried out based on six stages, but they do not have to be sequential in practice; these stages can interchange positions. Implementation of the

game using Articulate Storyline 3 software with four main characters, namely Sri Rama, Dewi Sintha, Sugriwa, Subali, and Jatayu puppets. The puppet characters are famous figures, making the game attractive for children as a learning medium and sharpening their knowledge about shadow puppets and counting. It can educate them that Balinese shadow puppets are a cultural art that must be preserved. The test results using the black box testing method have shown that the match between the storyboard and the testing of each component in the game has worked well. UX testing on users resulted in a score of 75.66% (SUS), which means Good, 85% (UMUX), which means Excellent, and 86% (UMUX-LITE), which means Excellent. All three types of testing state that the game is suitable for use.

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