

Design and Development of Cross Word Game with Bali Traditional Dance Theme using Unity

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Abstract- Traditional Balinese dance embodies the cultural identity and Hindu values of the Balinese people. However, rapid globalization and technological advancements have contributed to a decline in interest among the younger generation. To address this issue, this research aims to design and develop a desktop-based educational crossword game using the Unity engine to reintroduce traditional Balinese dance. The application integrates cultural learning materials—covering dance origins, synopses, performances, and preservation efforts—with interactive crossword puzzles. The system's functionality and usability were evaluated using Black Box testing and the System Usability Scale (SUS) involving 40 respondents. Evaluation results demonstrated that all 18 core application functions operated successfully. Furthermore, usability testing yielded a SUS score of 83.75, indicating that the game has an excellent level of usability and high user acceptance. Ultimately, this educational game serves as an effective, accessible, and engaging digital medium for the younger generation to learn and preserve traditional Balinese culture.

Index Terms— Educational Game, Crossword Puzzle, Unity, Traditional Balinese Dance, System Usability Scale (SUS).

I. INTRODUCTION

Indonesia is known as a country with an abundant cultural heritage. In 2020, the Ministry of Education and Culture recorded 1,239 cultural heritage elements, including performing arts, oral traditions, customs, traditional knowledge, crafts, and celebrations [1]. One prominent form of performing art is dance, which is a combination of movement and other artistic elements such as vocal and instrumental music [2].

In general, dance is categorized into traditional dance and creative dance. Traditional dance represents works and styles passed down through generations and is generally anonymous, as it reflects the collective expression of a community. In contrast, creative dance emphasizes freedom of artistic expression [2]. The diversity of historical backgrounds, social systems, and cultural values across regions has produced distinct dance characteristics and styles, such as Sundanese, Javanese, Balinese, and Minangkabau styles.

Bali, as one of the culturally rich regions, has a strong dance tradition that serves as a social identity for its people. Initially, Balinese traditional dance functioned as a medium of religious expression and worship. However, younger generations' interest in traditional dance has tended to decline due to the influence of globalization and the influx of foreign cultures [2]. The development of information

technology has also contributed to shifts in local cultural values, making adaptive preservation efforts necessary in response to modern developments [3].

On the other hand, technological advancement offers positive opportunities, one of which is the development of educational games. Educational games are designed to support the achievement of learning objectives while increasing learning motivation [4]. The advantage of educational games lies in their interactive visualization, which can enhance users' logic and understanding, as evidenced by research conducted at MIT. In addition, educational games can make the learning process more engaging, flexible, and effective [5].

One form of educational game is the crossword, a word-filling game based on completing boxes according to given clues. This game is not only recreational but also capable of training memory, analytical skills, and user creativity [6]. In its development, game applications can be built using game engines such as Unity, which supports 2D/3D object processing, audio, textures, and C#-based programming [7]. Based on this background, developing an educational crossword game application themed around traditional Balinese dance is an innovative alternative to support the preservation of local culture. Through a learning-while-playing approach, it is expected that younger generations can better recognize and understand the richness of traditional Balinese dance engagingly and interactively.

The purpose of this research is to develop an educational

crossword game application themed on traditional Balinese dances and to test the usability of the developed application.

II. METHOD

A. Research Flow

The research was carried out from December 2023 to July 2025. The research stages are illustrated in Figure 1.

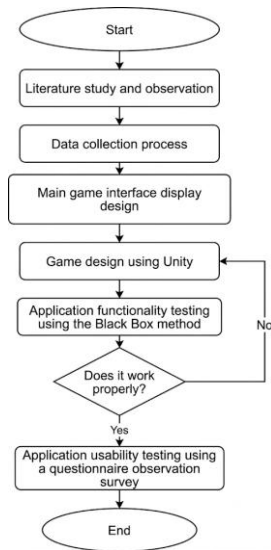


Fig. 1. Research Stage Flow of Design and Development for the Cross Word Game

Step 1. Literature Study and Observation

The initial stage of the research was conducted through a literature study and observation by reviewing various journals related to game application development using Unity, as well as references on Balinese culture as the conceptual foundation of the research.

Step 2. Data Collection

Data were collected from various sources such as the internet, scientific articles, and direct documentation in image formats (JPG, PNG). These data were used as supporting datasets in developing the content for each game level.

Step 3. Interface Design

The user interface design was created using Adobe Photoshop software. The design results were then exported to Unity as the initial prototype of the main display of the game application.

Step 4. Game Development Using Unity

The development stage was carried out using the Unity game engine with the C# programming language and the UnityEngine library. The programming process was supported by Microsoft Visual Studio as the IDE. After implementation was completed, initial testing was conducted using the Unity Test Framework to ensure that the system functionality operated properly.

Step 5. Functionality Testing (Black Box Testing)

Functionality testing was conducted using the Black Box method to evaluate system functions based on input and

output without reviewing the program code. This testing aimed to identify errors or bugs that needed to be fixed.

Step 6. Usability Testing

The final stage was usability testing using a questionnaire-based survey method. This evaluation aimed to measure the level of user satisfaction and ease of use of the application based on user perceptions, serving as a basis for further improvement and development.

B. Game Overview

The general overview of the crossword game application describes a puzzle game that requires players to fill in empty boxes with correct answers based on the provided clues. The developed application adopts the theme of traditional Balinese dances therefore, all questions presented are related to the types, history, and cultural elements of traditional dances in the Province of Bali. A general illustration of the game is shown in Figure 2.

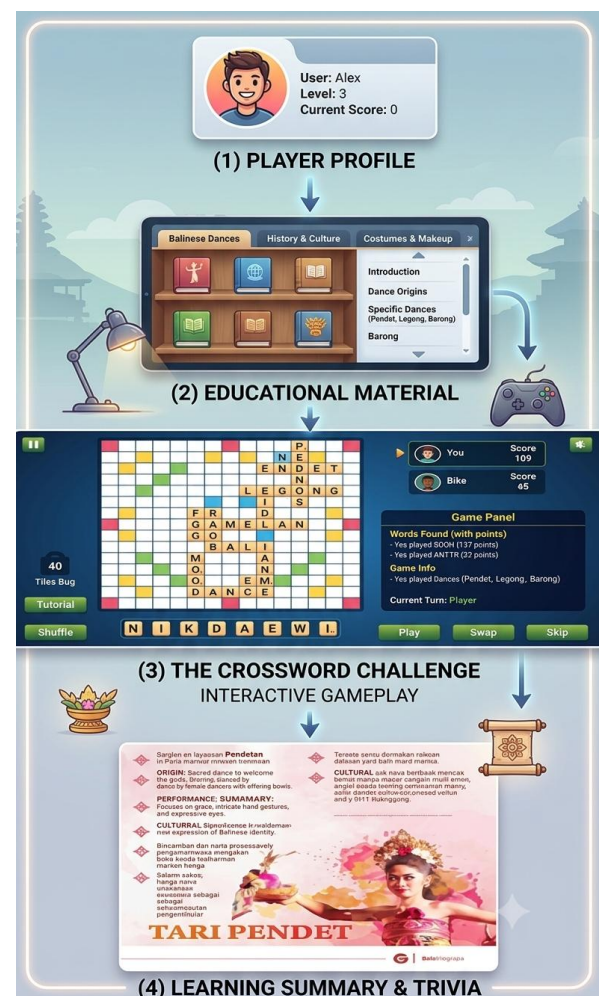


Fig. 2. General Illustration of the Game

C. System Modeling

This stage is used to determine the interactions between actors and the developed system. The use case diagram is

shown in Figure 3.

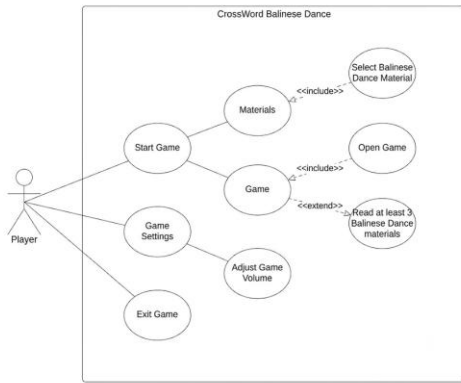


Fig. 3. Use case diagram of the game system

In Figure 4, we can see the activity diagram of playing the game, the player begins by selecting the Start Game button on the main page, which then directs them to the Material and Games Selection page. The player can choose the Material button to read learning materials from various traditional Balinese dance topics. Alternatively, the player can select the Games button to play the crossword game.

At this stage, the system checks whether the player has read the material, since the main requirement to play the game is that the material must be read first. If the player has not read the material, the Games button cannot be accessed. However, if the player has completed reading the material, the system will display the available game level options for the player to choose from.

After selecting one of the levels, the system will display the selected game level page. This page presents questions related to two traditional Balinese dance materials along with answer boxes that the player must fill in. The player can only answer the questions sequentially according to the question number. The answer box will change color to green only when the player provides the correct answer.

If the player successfully answers all questions correctly, a Trivia Page will be displayed. This page shows brief trivia about the dances included in the questions, along with the total time taken by the player to complete the game. There are also two buttons available: a Back button to return to the level selection page, and a Next Level button to proceed to the next game level.

III. RESULT

Upon launching the app, the Player (Figure 5a) is greeted by the Start Game display, which also provides access to Settings for game information and audio adjustments. From the main menu, the core experience branches into a selection between learning materials and gameplay. By choosing the Material (Figure 5b) option, users can navigate the Material Selection display to read detailed content about various traditional Balinese dances, including their history, costumes, synopsis, and preservation efforts. Once users have studied the materials, they can proceed to the Game (Figure 5c) section. This phase includes a Level Selection page and accessible Game Instructions, leading to the main

crossword puzzle where players must answer questions based on the dances they just learned. Upon completing a crossword level, users transition to the Trivia (Figure 5d) display. This final page presents brief trivia about the featured dances, shows the player's total completion time, and provides options to either return to the level selection or advance directly to the next level.

Black Box Testing was conducted as a functionality test of the completed game. The testing was carried out by the developer without reviewing the program code to ensure that all features available to players functioned properly and as intended. A total of 18 functional test scenarios were performed, as shown in Table 1. Based on the results shown in Table 1, the functionality testing conducted through 18 test scenarios indicates that all scenarios were completed without any errors found in the game application. All provided game features and functions operated properly and performed as intended for the players.

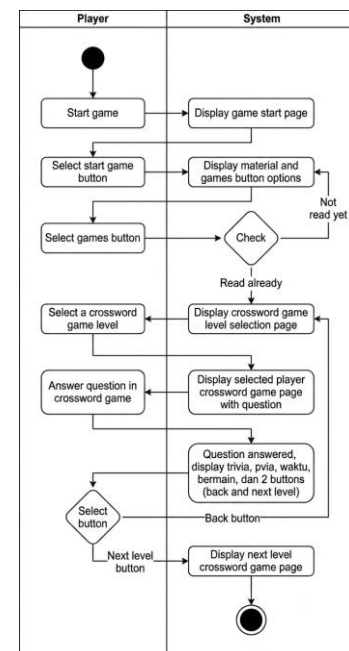


Fig. 4. Activity diagram of the Game

The System Usability Scale (SUS) was used to evaluate the usability of the Cross Word Balinese Dance game application. The testing was conducted by distributing a 10-item questionnaire to respondents. A total of 40 respondents participated in this survey, consisting of 22 members of the general public and 18 Balinese art practitioners, with an age range from 13 years old to adults. There were two methods of questionnaire administration in this usability test: printed (physical) questionnaires and online questionnaires distributed via Google Forms. After collecting the respondents' data, the SUS score was calculated using the standard scoring procedure. For odd-numbered questions, the contribution score was calculated using the formula: $\text{Score} = \text{scale position} - 1$ ($X - 1$) for even-numbered questions, the contribution score was calculated using the formula: $\text{Score} = 5 - \text{Scale position}$ ($5 - X$) the total

contribution score was then multiplied by 2.5 to obtain the overall SUS score, which ranges from 0 to 100. In Table 2, each respondent's name is represented by the letter N (N1–N40). The results of the questionnaire calculations are presented in Table 2. From the calculation results, the final SUS score obtained was 83.75. The interpretation of the final SUS score based on the SUS scale is as follows: Based on the Acceptability Range, the final SUS score of 83.75 falls into the Acceptable category. Based on the Grade Scale, the final SUS score of 83.75 is classified as Grade B. Based on the Adjective Ratings, the final SUS score of 83.75 falls into the “Excellent” category.

IV. DISCUSSION

Based on the results of the research conducted on the design and development of the crossword game application themed on traditional Balinese dance, the following conclusions can be drawn:

The Cross Word Balinese Dance application was developed using the Unity game engine with the C# programming language and supported by Microsoft Visual

Studio Code as the editor and compiler. The application provides two main modes: a crossword game mode and a material mode containing information about traditional Balinese dances.

The functionality testing using the Black Box method showed that all application features operated according to the designed specifications. The testing was conducted through 18 test scenarios, and all scenarios were successfully completed without any detected errors (bugs). Therefore, it can be concluded that the system functions properly.

Usability testing using the System Usability Scale (SUS) method involved 40 respondents through both online and offline questionnaire distribution. The calculation results obtained an average score of 83.75. Based on the SUS interpretation scale, this score falls into the Acceptable category in the acceptability range, achieves Grade B on the grade scale, and is classified as Excellent in adjective ratings. Thus, the application has a good level of usability and is well accepted by users, although there is still room for further development and improvement.”



Fig. 5. The cross word game application interface

TABLE I
BLACK BOX TESTING AND RESULT

Code	Test Case	Expected Result	Test Result	Conclusion
AU01	Start the game	The Material and Games page is displayed to the player	The Material and Games page is displayed	Successful
AU02	Open Balinese dance material options	The material selection page is displayed	The Balinese dance material selection page is displayed	Successful
AU03	Open/read selected material	The selected Balinese dance material content page is displayed	The selected Balinese dance material content page is displayed	Successful
AU04	View other Balinese dance materials	The page containing other Balinese dance material options is displayed	The page containing other Balinese dance material options is displayed	Successful
AU05	Open level selection page	The game level selection page is displayed	The game level selection page is displayed	Successful
AU06	Open game level before reading material	The game box icon cannot be clicked and the level page cannot be displayed	The game box icon cannot be clicked	Successful
AU07	Open/read game instructions	<i>A pop-up containing game instructions is displayed</i>	<i>The instruction pop-up is displayed</i>	Successful
AU08	Select a desired game level	The game page with the selected level is displayed	The game page with the selected level is displayed	Successful
AU09	Answer game questions	The player's answer appears in the answer box	The player's answer appears in the answer box	Successful
AU10	Complete the game	All answer boxes turn green and the trivia page appears	<i>Answer boxes turn green and the trivia page is displayed</i>	Successful
AU11	Proceed to the next level	The next level game page is displayed	The next level game page is displayed	Successful
AU12	Return to level selection page	The level selection page is displayed	The level selection page is displayed	Successful
AU13	Return to previous page	The previous page is displayed	The previous page is displayed	Successful
AU14	Return to start game page	The start game page is displayed	The start game page is displayed	Successful
AU15	Open settings page	The settings page is displayed	The settings page is displayed	Successful

AU16	Adjust game volume in settings	The audio sub-page is displayed and volume can be adjusted	The audio sub-page is displayed and volume can be adjusted	Successful
AU17	View application information in settings	The About sub-page is displayed and information can be viewed	The About sub-page is displayed and information can be viewed	Successful
AU18	Exit the game	The player exits the game	<i>Game selesai dan pemain keluar dari game</i>	Successful

TABLE II
SYSTEM USABILITY SCALE RESULT

N	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Jumlah	Nilai Sementara
N1	5	2	5	1	5	1	5	1	5	2	38	95
N2	5	2	5	1	5	1	5	1	5	2	38	95
N3	5	2	4	1	4	3	5	1	3	3	31	77,5
N4	5	2	5	1	5	1	5	1	5	2	38	95
N5	5	2	5	1	5	1	5	1	5	2	38	95
N6	5	2	4	1	4	3	5	1	3	3	31	77,5
N7	4	3	3	4	4	2	3	3	3	4	21	52,5
N8	4	3	3	4	4	2	4	2	4	4	24	60
N9	5	2	4	1	4	3	5	1	3	3	31	77,5
N10	5	2	4	1	4	3	5	1	3	3	31	77,5
N11	5	2	4	1	4	3	5	1	4	3	32	80
N12	5	2	4	1	4	3	5	1	3	3	31	77,5
N13	5	2	4	1	4	3	5	1	3	3	31	77,5
N14	5	2	5	1	5	2	5	2	2	3	32	80
N15	5	2	4	1	5	2	5	1	3	2	34	85
N16	5	1	5	2	4	1	5	1	5	2	37	92,5
N17	5	1	5	2	4	1	5	1	5	2	37	92,5
N18	5	2	4	1	4	1	4	2	5	2	34	85
N19	5	2	5	4	4	2	5	1	5	3	32	80
N20	5	2	5	1	5	1	5	1	5	2	38	95
N21	5	1	5	1	4	2	5	1	5	1	38	95
N22	5	1	5	1	5	1	4	1	5	1	39	97,5
N23	5	2	5	2	5	1	5	1	5	1	38	95
N24	4	2	4	3	3	3	4	2	4	3	26	65
N25	5	1	5	1	5	2	5	1	4	2	37	92,5
N26	5	3	5	1	4	2	5	1	5	3	34	85
N27	5	1	5	2	5	4	5	2	5	2	34	85
N28	5	1	5	2	5	1	5	2	5	2	37	92,5
N29	5	2	5	2	5	2	4	1	5	1	36	90
N30	5	1	5	2	4	4	4	2	5	1	33	82,5
N31	5	2	5	3	5	1	4	2	4	2	33	82,5
N32	5	2	4	2	5	2	4	1	5	2	34	85
N33	5	2	4	2	4	2	4	2	4	2	31	77,5
N34	5	1	5	2	4	2	5	1	5	1	37	92,5
N35	5	1	5	3	5	2	5	1	5	2	36	90
N36	5	1	5	2	5	2	5	1	5	2	37	92,5
N37	4	2	4	1	4	3	4	2	4	4	28	70
N38	4	2	4	2	4	2	3	3	4	4	26	65
N39	4	1	5	1	4	1	5	1	5	2	37	92,5
N40	4	2	4	2	4	2	4	2	4	2	30	75
Nilai rata-rata											33,5	83,75

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