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Design and Evaluation of a Digital Learning Game of Early Education: The Story of Penguin and Panda

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A B S T R A C T

As the time changes, technology improves and human being adapted with technology to overcome the pandemic, indicates that the way people lives also improved significantly. The technology also used in education as a learning media. Because the power of media is so wide, and it can be used to educate people at very little cost. One effective way to integrate technology into the learning process is using educational games. The game that was developed is a story-based game that can be created in the form of a mobile application. This game will contain a story that uses animation as the medium, in the game questions related to the story will be presented both in the middle of the game and at the end of the game. The evaluation is conducted using heuristic evaluation with 20 questions regarding the quality of the game. As conclusion, according to the evaluation result, future developments are needed in the user delight aspect and performance the most. Other than the evaluation results, there are certain features also could be added to improve the effectiveness of the game such as content customization, allowing the material to be tailored to specific classes or individual learners.

A R T I C L E   I N F O

1. INTRODUCTION

The learning process has developed rapidly. The class is no longer using traditional methods but also adapting technology which produces a more effective and interesting learning system. As technology advances, the learning system must also keep up with technological developments and the times. The usage of digital devices like the internet, computers and newspaper are the new form of learning in this era. Moreover, mass media play a fundamental role in all type of increases which allow the public to rapidly contact, evaluate, share and move either data or knowledge. Media plays a very significant role in the field of education. Media is field which works on a broad scale, both the social and mass media played different task. Because the power of media is so wide, and it can be used to educate people at very little cost. During online teaching many of persons can be taught at the same time. And at that point allow students and teachers to connect and share their ideas. As Dr. Parmar (2014) states, media has the potential to transform education by expanding access and reducing barriers to information.

The use of technology in the learning process has increased drastically, especially after the swift change when everything improves the technology so that almost all fields experienced dependence on technology and all fields know technology much better than before. Moreover, technological developments in the world of education are very influential. The entire learning system has moved online and uses many new technologies to assist learning. Even though not the entire learning process can move online, there are many technological innovations that can cover the shortcomings of online learning systems. As learning is now back to normal, it is time to maximize the use of technology in the learning environment.

One effective way to integrate technology into the learning process is through the use of educational games. As information technology advances, digital educational games have emerged as a novel and noteworthy tool for academic innovation, garnering increasing societal attention and exploration. These games, based on computer and Internet technologies, are highly favoured by educators and students alike due to their unique learning methods and interactivity. In contrast to traditional education approaches, digital educational games offer learners a fresh and distinctive learning experience, presenting educational content in a gamified format that simulates real-life scenarios, thus creating a captivating and interactive learning environment. These games find extensive application across various subject areas, encompassing language learning, mathematics, science, humanities, and social sciences. They serve as valuable supplements to classroom teaching and assume a vital role in diverse educational settings such as independent learning, supplementary teaching, and personalized education (Li, 2021). Other than that, a lot of studies explored the benefits of learning process using game-based learning media and potentially improve student motivation, engagement, and understanding across subjects such as language, science, and mathematics (Gee, 2007; Prensky, 2001). Compared to traditional learning process, educational game simulates real-life scenarios and allows learners to actively participate in knowledge construction.

The use of learning media also helps the students to understand about the subject during education process. Educational process is not focused on what teacher teach anymore but the students need to take an active part to try and learn new things by themselves with the help of teacher as supporter. Learning media such as game will help students to experience and learn things in an effective and fun way. Following the development of the learning

system in Indonesia, the latest curriculum set a high level of education even in early education and it designed to have English to be teach in a very early education. Balancing more difficult lessons with easier learning methods can be achieved by utilizing educational games.

2. METHODS

This research uses a heuristic evaluation approach to evaluate the effectiveness and usability of the educational game as a medium for English learning. Instead of collecting user data through surveys or questionnaires, the evaluation was conducted by the researcher using structured, game-specific heuristics. Pinele, Wong and Stach (2008) stated that video game is design to entertain and engage the user with several aspects to create a compelling experience for users. Failure to do so, can have a negative effect on the overall quality and success of a game. Heuristic evaluation included several game categories like gameplay, skill development, tutorial, strategy and challenge, game/story immersion, coolness, usability or game mechanics and game control (Desurvire and Wiberg, 2009).

2.1. Development of the Educational Game

The game that will be developed is a story-based game that can be created in the form of a website or mobile application. This game will contain a story that uses animation as the medium, in the game questions related to the story will be presented both in the middle of the game and at the end of the game. There are 2 types of questions asked, the first question is about the story in the game so it will produce different endings according to the choices he chooses. By making this game, students not only play but can learn various things, starting from listening, reading, understanding and responding. This game will use a hierarchical type, where the game will run linearly. This game will also be fully controlled by students.

The development process progressed through several stages to ensure a high-quality fine product. It started with planning the content and material by researching the curriculum that nationally used in early education and align the content with the learning objective accordingly. After carefully arrange the content, storyboard created to map out the game narrative flow and structure to keep the stories align with the material difficulties. To create a flawless user interface, navigation and game structure, wireframe is developed through out the whole game play and UI structure. There stages serve as a guide to ensure that the game design was align with the content and material to reach the educational goals.

The following stages is to create the in-game asset needed such as user interface, game asset and animation including character, background, object and sound effect. The user interface was designed with the theme that related to the story or content that was offered in this early develop game. Meanwhile, the animation created to enhancing its interactivity and accessibility and maintaining player interest. The animation was developed based on the designation curriculum goals and the animation have additional content such as manner and common sense. The whole game is created with attention to details and ensure that the game play can be effectively used and offer an interesting and fresh learning experience.

After going through the game design and art, the last part of the development process is building the game using articulate storyline. Rigorous test and debugging were done at the end of the development process to ensure that the mechanics, logic, and interactive features run smoothly and give the perfect performance to give user the experience.

2.2. Evaluation of the Educational Game

The evaluation process for the educational game is to check the effectiveness and the quality of the educational game using a checklist. The questions included 20 questions focusing on, learnability, performance system, discoverability, efficiency, and delight.

Table 1. questions for the evaluation process

No	Question
Learnability	
1	Instructions for using the media are clear
2	Instructions for using media according to the media
3	Media can be understood easily
System Performance	
4	Media can be used in various types of cellphones and computers
5	The media does not error when used
6	Media does not fail in getting orders and generating value
7	All features can be used properly
8	The feature does not bother the user
Discoverability	
9	Users can easily use the media
10	The questions and results in the media are correct
Efficiency	
11	The user interface used is in accordance with the theme and can be used in early education
12	Media can have a positive impact on students in learning English lessons
13	Questions in the media can be understood easily
14	The questions in the media are in accordance with early school material
15	Media can be used as additional learning media
Delight	
16	The use of colors in the application does not distract the user
17	The text in the media can be read well
18	Animated videos in media can be played well
19	Audio in the media can be heard clearly
20	The animation display is understandable

3. RESULTS AND DISCUSSION

3.1. Development of the Educational Game

The game was design as a hierarchical type of interactive media, where the navigation and the playthrough follow a predefined order, guiding the user to experience the game in a systematic and logical sequence according to game design that also align with the learning goals. With the hierarchical type of interactive media, user will go through the game in

particular order and ensure a clear learning progression. This also allow user to learn from the basic to more advanced topics without creating a confusion.

In this game design, user required to engage with the game actively. For instance, the player might need to do some action like solving problems or make a decision that also can create a different result based on the player's action. The game progression will be unlocked automatically whenever the player finished the previous stages. In the middle of the game play other than solving problems and make decisions player will also faces a question-and-answer section to make sure that the goals of a certain stages have been fulfilled before continuing to another or the more advanced level. This feature was design to emphasize user involvement and reinforce the experience of the game progression.

The hierarchical structure used in the game design to also build complexity as the user advances. This will ensure that the player have mastered prerequisites knowledge before moving on to a more advanced stages or level that was available in the game. Additionally, this method of interaction also has a feature to give feedback-such as showing correct answer or providing hints or guide to user for a better understanding of the gameplay.

The game design that provided in this early development game is aligned with the curriculum of English education in early education, offering an interesting and engaging platform to build foundational skill such as vocabulary, grammar, and pronunciation. Through out the entire gameplay, user will face a few types of interaction such as, drag and drop items, make a decision or choose an action and completing the puzzle. This feature will also reinforce learning through feedback or result that might concur along the way through the gameplay. Wireframe of the game refer to a simple, and child-friendly navigation and layout with intuitive navigation, ensuring accessibility for a young learner.

The next stage of development is transforming the game design and wireframe into a fully design User Interface (UI) and developing the animation that become a huge benefactor to bring the game's story to life. The UI designed with an appealing UI element visual, such as icons, buttons, menus, stages, and choices to create an intuitive and engaging experience for player. Game art style also design based on the theme of the story that offered in the game to ensure the interface is visually appealing for the target audience. The navigation of the gameplay avoided unnecessary hidden navigation and made as simple as possible to avoid confusion that can lower the immersion of the gameplay.

The purpose of having an animation throughout the gameplay is to convey the game narrative and add depth to the interactive experience. Player can feel the consequences of the choice they make through the animation. These animations will be used to illustrate the storyline, introducing characters, force the user to listen to the story and read the story along the way of the gameplay. This method used to ensure that the content is presented to engage user in an immersive way. This process will form a polished and dynamic learning tools as a learning media.
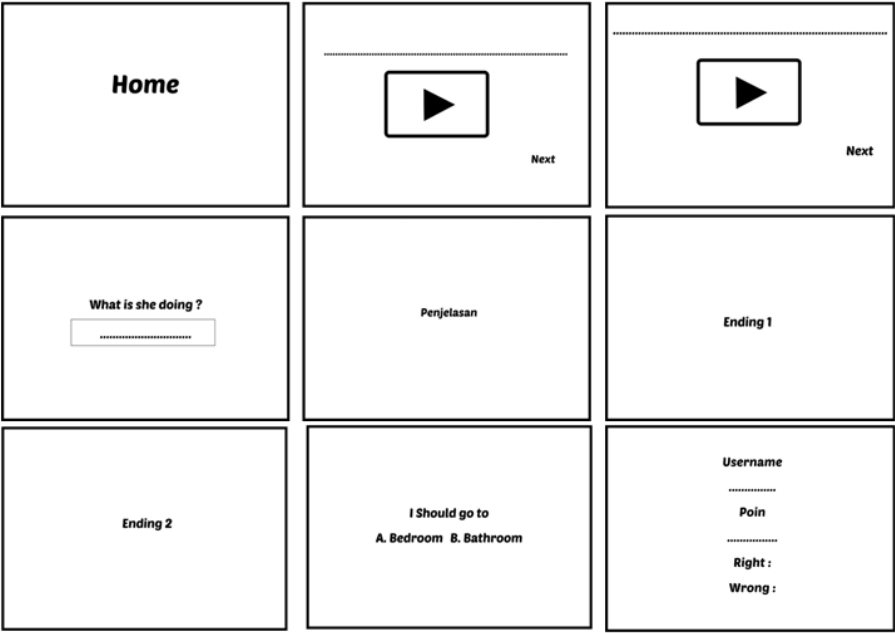
Figure 1. Daily variation in the sedimentation of the sludge at the outlet of the WWTP flocculator.

Figure 2. Daily variation in the sedimentation of the sludge at the outlet of the WWTP flocculator.
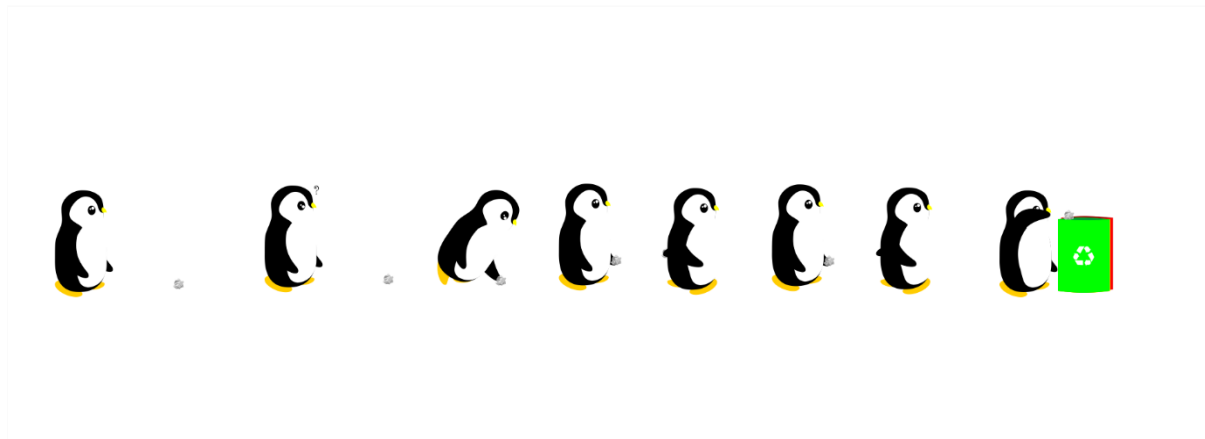
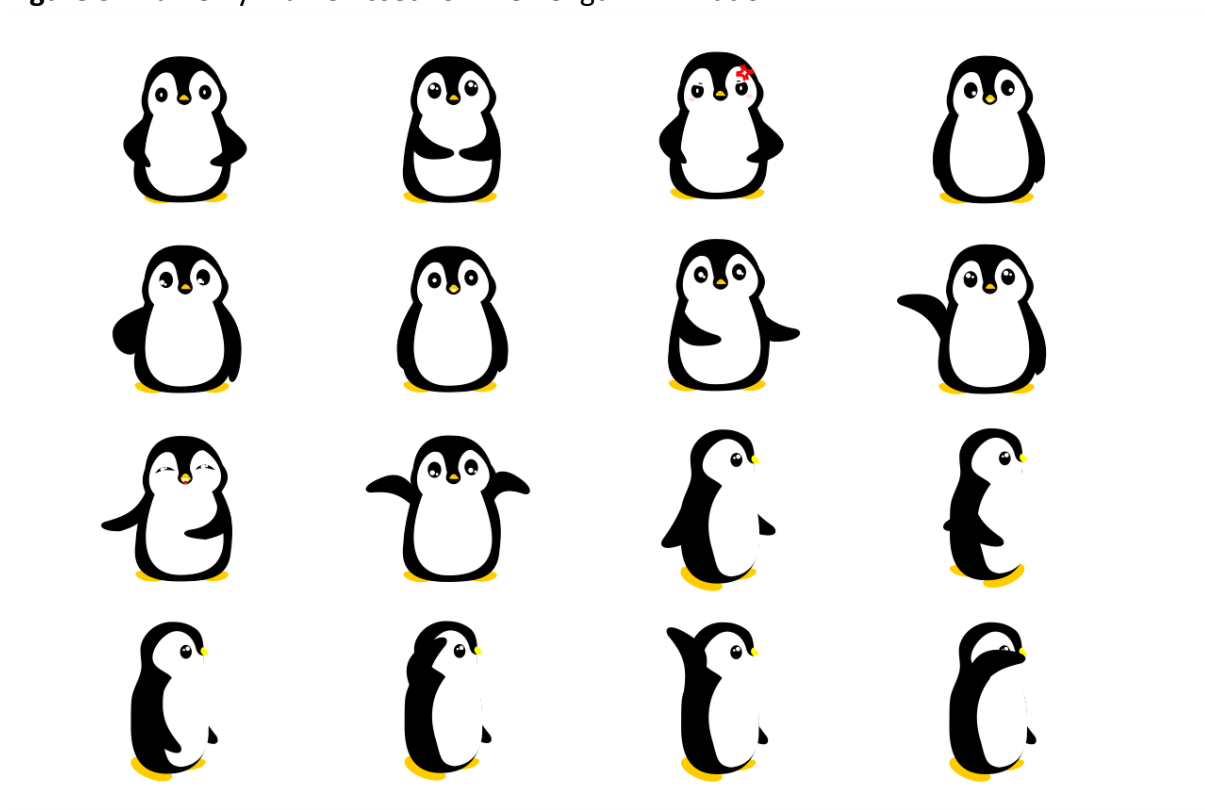**Figure 3.** Frame By Frame Asset For The Penguin Animation.

Figure 4. Character Design of The Penguin.

3.2. Evaluation of Educational Game

The Story of Panda and penguin developed with the purpose as a learning medium for English education. To determine the effectiveness of the media, the evaluation step is crucial. This step involves assessing various aspect of the game, such as learnability, system performance, discoverability, efficiency, and user delight. The 5 aspects will be a criterion to evaluate how well the media function as a learning media and evaluate its effectiveness. The media was evaluated using heuristic evaluation. Heuristic evaluation is a method where the developer or evaluator reviews the system against a set of established usability principles (Nielsen, 1994). For games, a more specialized set of heuristics was used, based on the

framework by Pinelle, Wong, and Stach (2008), which emphasizes player control, feedback, and support for varied gameplay styles.

Pinelle et al. (2008) developed their game-specific heuristics to address limitations in applying traditional UI heuristics to interactive games. Using this method, the evaluation highlights the importance of clear feedback, responsiveness, and minimal cognitive load in gameplay (p. 1453). This method is helpful for solo evaluations, allowing the developer to systematically identify usability flaws. To ensure that the media can provide great experience for the player, the PLAY heuristics from Desurvire & Wiberg (2009) were also consulted. These evaluations focused on areas like immersion, challenge, and fun. This evaluation can help the evaluating "delight" aspects of the game.

The evaluation was conducted by developers by playing through the game systematically and reviewing it using heuristic evaluation method that conducted in a question list consisting of 20 questions that are group based on learnability, system performance, discoverability, efficiency, and user delight. This question is designed based on heuristic evaluation and covers the evaluation to measure the quality of the games so the game can meet usability and design standard to achieve its purpose. The evaluation of educational games conducted solely by the developer, focusing on internal testing and ensuring the basic functionality of the game. However, future development will include feedback from both teachers and students to assess the game's effectiveness in real education setting and to support further improvement.

The evaluation is rated at the rate between 1 to 5, which 1 indicates this aspect is having major issue and 5 indicates a great performance of those aspects. The issues were documented and evaluated thoroughly to create improvement steps for future development.

No	Question	Rating
Learnability		
1	Instructions for using the media are all written in the media	4
2	Instructions for using media according to the media	4
3	Media can be understood easily	4
System Performance		
4	Media can be used in various types of cellphones and computers	3
5	The media does not make error when used	3
6	Media does not fail in getting orders and generating value	3
7	All features can be used properly	3
8	The feature does not bother the user	3
Discoverability		
9	Content in the media align with the media goals	4
10	The questions and results in the media are correct	4
Efficiency		
11	The user interface used is in accordance with the theme and can be used in early education	4
12	Media involved content that included in English material for early education	4
13	Questions in the media designed for early education students	4

No	Question	Rating
14	The questions in the media are in accordance with early school material	4
15	Content in the media progressively build accordingly to support the learning process	3
Delight		
16	The use of colors in the application does not distract the user	3
17	The text in the media can be read well	3
18	Animated videos in media can be played well	3
19	Audio in the media can be heard clearly	3
20	The animation display is understandable	3

After thoroughly evaluating the game, there are some issues and keys to improvement that are needed. There aren't major issues that were found while evaluating the media, but overall evaluation didn't reach an impressive result which indicated future developments needed. According to the evaluation result, future developments are needed in the user delight aspect and performance the most.

Other than the evaluation results, there are certain features also could be added to improve the effectiveness of the game. One notable improvement that can be made is adding content customization, allowing the material to be tailored to specific classes or individual learners. This feature will enable easier alignment with different curriculum and give more flexibility to support the learning process. This could also add more effectiveness to the game so users can make the media adapt the content to meet the needs of diverse student groups.

4. CONCLUSION

As the time changes, technology improves and human being adapted with technology to overcome the pandemic, indicates that the way people lives also improved significantly. The technology also used in education as a learning media. Because the power of media is so wide, and it can be used to educate people at very little cost. During online teaching many of persons can be taught at the same time. And at that point allow students and teachers to connect and share their ideas. As Dr. Parmar (2014) states, media has the potential to transform education by expanding access and reducing barriers to information.

One effective way to integrate technology into the learning process is through the use of educational games. As information technology advances, digital educational games have emerged as a novel and noteworthy tool for academic innovation, garnering increasing societal attention and exploration.

The game that was developed is a story-based game that can be created in the form of a mobile application. This game will contain a story that uses animation as the medium, in the game questions related to the story will be presented both in the middle of the game and at the end of the game. The game design that provided in this early development game is aligned with the curriculum of English education in early education, offering an interesting and engaging platform to build foundational skill such as vocabulary, grammar, and pronunciation. Throughout the entire gameplay, user will face a few types of interaction such

as, drag and drop items, make a decision or choose an action and completing the puzzle. This feature will also reinforce learning through feedback or result that might concur along the way through the gameplay. Wireframe of the game refer to a simple, and child-friendly navigation and layout with intuitive navigation, ensuring accessibility for a young learner.

At the end of the development process, the evaluation was conducted using heuristic evaluation. Heuristic evaluation included several game categories to evaluate like gameplay, skill development, tutorial, strategy and challenge, game/story immersion, coolness, usability or game mechanics and game control. After evaluating the game, there are some issues and keys to improvement that are needed. Based on the result there are a few point that need a major improvement like system performance, and the User Interface of the game can be design to be more suitable for elementary school students. Overall, future developments are needed in the user delight aspect and performance the most. User Interface of the game can be design to be more suitable and aesthetically pleasing for elementary students and an easier and clear navigation. During the testing, a few inconvenience error was found even though it's not fatal error, in order to give smooth experience the system needs to be improves. Other than the evaluation results, there are certain features also could be added to improve the effectiveness of the game such as content customization, allowing the material to be tailored to specific classes or individual learners.

AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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