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Zoo Simulator to Increase Children Learning Phase

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ABSTRACT

The growth of kids' brain could be optimized by recognizing something. Learning to recognize animals is one of the methods to stimulate the children's brain growth to imagine. Nevertheless, kids tend to spend all their time by playing and could not focus to recognize the animals due to the way of learning which is usually not interactive and not interesting. Therefore, a game application was designed and developed to be used as a way to help children in recognizing the animals. This program was developed as a mobile game application with the animation and attractive display to increase the kids' interest to learn the animals. Beside that, Fisher-Yates shuffle algorithm has been successfully implemented on the game to randomize the images which can be found on puzzles, randomize the answers in image guessing puzzles, randomize animals to choose which can be sold, randomize the foods which will be given to the pets, and randomize the initial position to create patterns on rescue rare animal puzzles. After the implementation and testing on the game application, it proves that it could increase the kids' interest in learning new animals to 4.18 in ARCS interest measuring index compare with textbook method which only 2.74.

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1. INTRODUCTION

The introduction of a new thing on children should be given on early dates. According to Hartati [1], children, usually having a great curiosity, is a unique individual, has the potential for learning and likes to imagine and phantasm. It can be concluded that children has the most suitable age to be provided with an introduction to something new so that children can optimize their growing. According to Hurlock [2], the age range that can be classified as kids is between 2 – 12 years old.

The first five years of age is a period of rapid brain development that is often called as the golden age. Children with age of the first five years have photographic memory, recalling as the eye of the camera [3]. Based on the research results done with children ages 4 years, the capacity of the children has reached 50%, and will reach 80% at the age of 8 years [4]. Age 5 was the ideal age for introducing them with new things, one of them is the introduction of the animals. Introduction of animals to children can stimulate the brain to imagine and train the children's creativity [5], and at the time was still in the peak of a child's brain development, so the kids are easy to catch things that are considered to be new and it is important for children to learn about animals [6].

In the introduction to the animal will typically use media, such as posters and encyclopedia, but the media has not been able to attract the interest of the child to know about animals [6]. According to Rigas and Ayad [7], an interesting, interactive, and fun media can attract children to stay focused on the activities being performed. Packaging a media introduction into the games will be more interactive and compelling [8]. Educational packing into the game is one of the methods of learning known as logical learning

progression [9]. In digital game, the player will be directed to master a game concept indirectly to complete the game [10].

Based on the research that has been done by Ainul [11], the application of simulation gaming media is proven can increase the motivation of students from 49.5% to 78%, and based on the research conducted by Winarti [12] it is proven can attract learning interest in children. This is due to the use of the gaming media which can increase children's attention visually through pictures, photos, sounds, and animations. The Fisher-Yates algorithm is an algorithm that performs shuffling image on the set of numbers [13]. The Fisher-Yates algorithm is a good random numbers genarator because this algorithm generates the same random array for every permutation. According to Haditama and Slamet [14], the Fisher-Yates algorithm will generate a random permutation which is ordered so as to make the question that has arisen will not appear again in the same session. Based on the above problems in this research, we will create an animal recognition as zoo simulator using Fisher-Yates algorithm to help increasing children's interest in the introduction of animals.

2. FISHER-YATES SHUFFLE ALGORITHM

According to Exridores and Sopryadi [15], the Fisher-Yates Shuffle algorithm is a better method of randomization or can be said to be suitable for randomization, with a rapid execution time and does not require a long time to do a randomization. The Fisher-Yates Shuffle algorithm is used to change the order of entries given randomly and permutations generated by this algorithm comes up with the same probability [16].

According to Atwood [17], the Fisher-Yates Shuffle is better than the Naive Shuffle algorithm. In Figure 1, the Fisher-Yates Shuffle has an average occurrence of the combination of randomization which is almost the same compared with Naive Shuffle that has a particular combination that often appears. The experiments tried to scramble 4-digit number as much as 600,000 times [17].

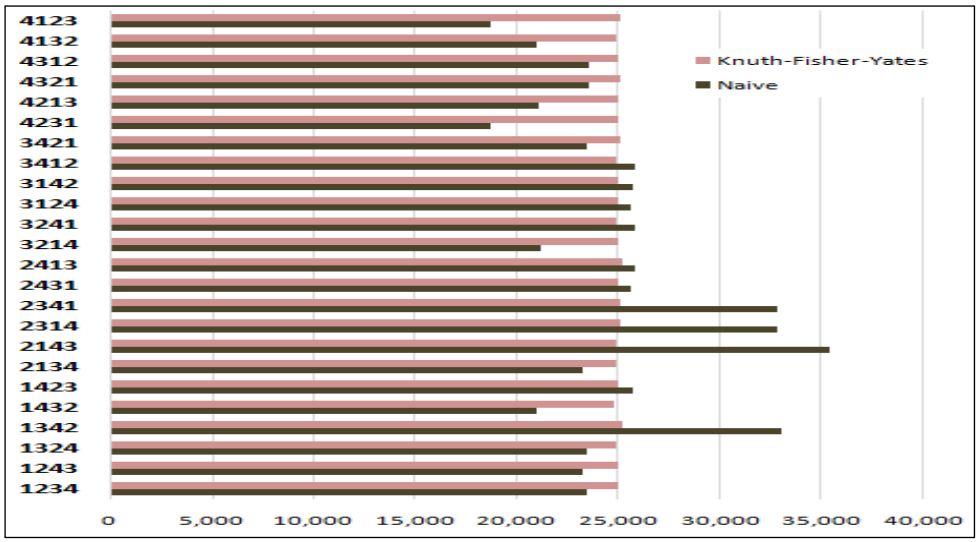

Figure 1. The comparison results of Fisher-Yates Shuffle with Naive Shuffle [17]

There are four steps in the Fisher-Yates Shuffle algorithm according to Exridores and Sopryadi [15].

a. Write down the numbers from 1 to N.
b. Pick a random number K between 1 up to the number of numbers that has not been crossed out.
c. Calculated from the beginning of the streak, the number K that has not been crossed out, and write down that number elsewhere.
d. Repeat step 2 and step 3 until all the numbers are already crossed out. The sequence of numbers written in step 3 is a random permutation of the numbers.

3. ARCS MEASUREMENT

Interest was driven by the desire of a factor after watching, observing, comparing, and considering the needs of the desired [18]. Interest in learning is a mental framework consists of a combination of motion and mixture of feelings, prejudices, anxious and tendencies of the other ordinary redirects the individual to a particular option [19]. Based on the proposed model of John Keller who has made an instrumental measurement of interest and motivation, interest in learning can be based on four main components, in accordance with the model, namely ARCS [20].

a. Attention
   The interest of learning activities must not only raised, but must also be maintained during learning activities taking place.
b. Relevance
   Related to the alignment of the learning material presented with a learning experience.
c. Confidence
   Related to the attitude of trust, i.e. will be successful or that is associated with the hope to succeed.
d. Satisfaction
   Complacency can arise from within the individual himself, called as intristik pride where individual feels satisfied and proud to have successfully executed, achieved, or get something.

Table 1 is the scoring interest of ARCS [21]. A positive statement with strongly agree criteria is given value 5 while the criteria of very disagree is given the value of 1. Negative statement valuation upside down from a positive statement, beginning with a scale of 1 to 5 which scales from strongly agree to strongly disagree.

Table 1. Index of ARCS

Criteria	Score	
	Positive Statements	Negative Statements
Strongly agree (SA)	5	1
Agree (A)	4	2
Neutral (N)	3	3
Not Agree (NA)	2	4
Strongly not Agree (SNA)	1	5

$$Average\ Score = \frac{\Sigma\ amount\ of\ respondents\ score}{\Sigma\ number\ of\ statement\ x\ number\ of\ respondents} \quad (1)$$

Equation (1) shows the formula to calculate the final score of the ARCS in the measurement of interest [21]. The average score can be generated from the sum of all positive and negative statements then divided by the number of statement multiplied by the number of the correspondents.

4. RESEARCH METHOD

Research methods used in this research are devided into six steps:

a. Literature Study

The literature study is the process of studying the theories associated with the games will be built, such as the making of the game with C # based Android application, the Fisher-Yates Shuffle, the types of animals and their characteristics, concepts and categories of educational games.

b. Needs Analysis

Needs analysis of features that would be needed to do the design and development of the simulation games, such as the script controller to be made, is done in this phase. The script controller is an object that serves as the setting of all the Groove system found in the game. Controller contained in a game is very diverse, such as the script controller animation, slider controller, and music controller.

c. Application Design

Flowchart design is created for easier viewing of the overall flow of the system. After the design completed, we proceed with the design of the player interface.

Figure 2 (left) is a general flowchart of the games. When the game starts, the program will directly check the file. If the XML file does not exist, it will be instantly created all of the XML. The next process calls the view controller which generally set which panels are off and which are on. After that the system will

do the checking whether there is a button that is pressed. If any button is pressed, the system will immediately call the controller that handles the buttons.

Figure 2 (right) shows the flowchart of Fisher-Yates shuffle algorithm. The process begins by taking the length of an array. If the array length is not greater than one, then the process will be directly quit. If the length of the array is more than one, set the temp value the same as the length of the array. After that, the temp value is decreasing 1. If the value is not greater than or equal to zero, then the process of randomization is considered complete. However, if the value of the temp is greater or equal to 0, then set the value x based on a random number starts from 0 to temp. Then switch index-to-temp with index-to-x, and decrease the value of temp with 1. After that repeat the process until the temp value equals zero.

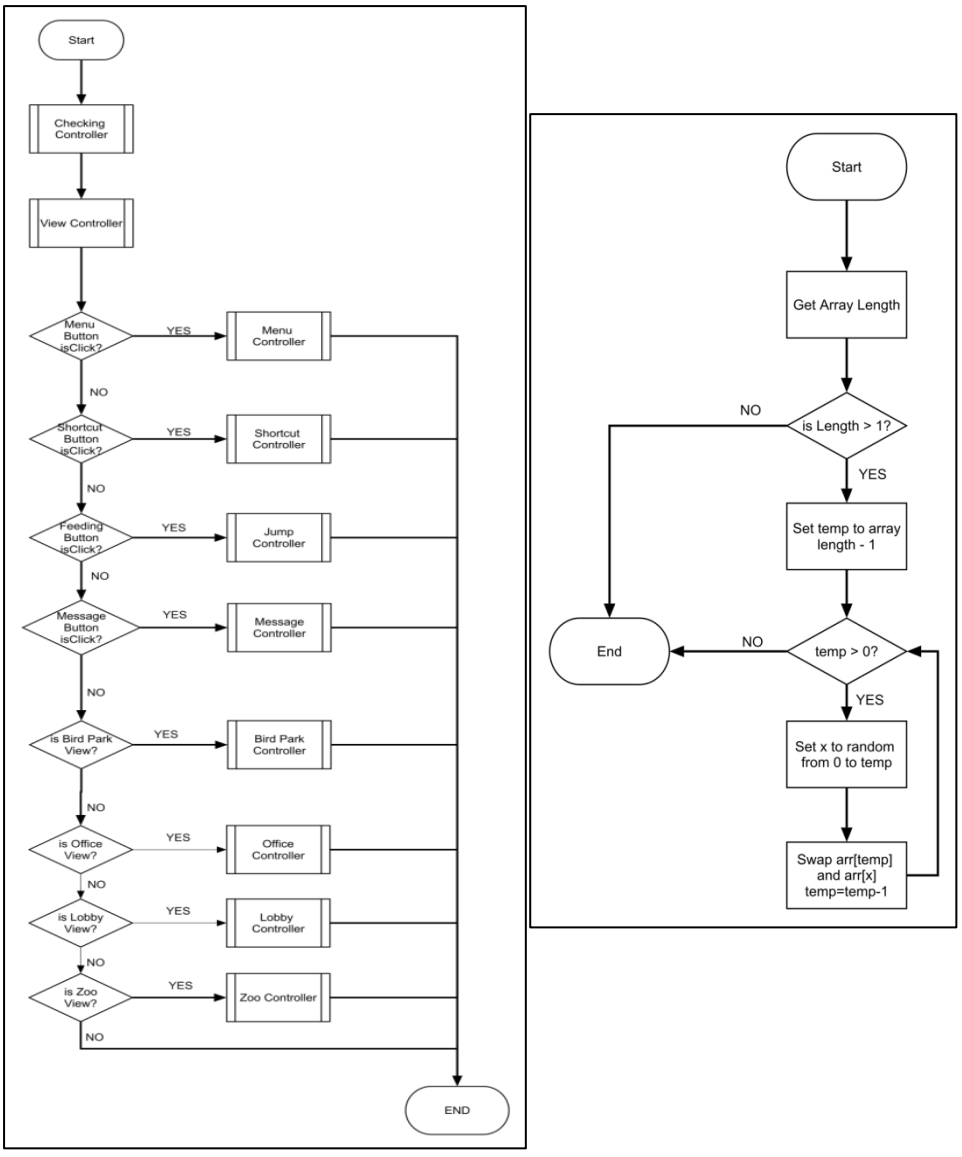

Figure 2. Main flowchart (left) and Fisher-Yates shuffle flowchart (right)

d. Application Development

Application development was using Unity version 5.1.3f1 (64-bit) and Mono Develop as the IDE (Integrated Development Environment). In the development of the game, programming language used is C #. The design of the sprite assets and other animations were created using Corel Draw X7 and Adobe Photoshop CS6.

e. Testing and Surveys

At this stage, the game application testing is performed by using the Samsung Galaxy Mega 6.3, Samsung Galaxy Grand Prime, and Xiaomi Redmi 3 smartphones. The process of testing performed on children with the age range between 5 to 8 years old.

Phases in testing are as follows.

1. The correspondent was given an introduction to animals using text book method.
2. The correspondent was given a questionnaire measuring their interest. During the filling of the questionnaire correspondents are given an explanation of the intent of each question.
3. The correspondent was given an introduction to the game (zoo simulator).
4. The correspondent was given a questionnaire measuring the interest back.
5. During the filling of the questionnaire, correspondents are given an explanation of the intent of each question.
6. Correspondents were asked to fill out another questionnaire regarding the look and navigation of the game.

f. Evaluation

At this stage, data that has been collected from survey before and after playing the game will be evaluated. ARCS is a false assertion method that is used to find out the percentage of success in introducing the animals game against the interest of learning, whereas Likert scale is a method of false assertion application used to find out the percentage of success the game application against assessment evaluation of the design of the user interface and navigation.

5. RESULTS AND ANALYSIS

Figure 3 is the display on the lobby panel which contains four buttons, i.e. zoo review, office, store (in the form of a building), and mini games (in the form of the building). Zoo review will call a popup that displays the grading on all zoos the player has, zoo office will display beasts data which have been obtained, the store serves to store.exe popup call that contains some States that can be purchased by players, and mini-games will feature a mini gaming scene in the Zoo Simulator. Figure 4 shows the cages containing animals with full hungry bar, and will generate a coin per minute.

Figure 3. Lobby panel display

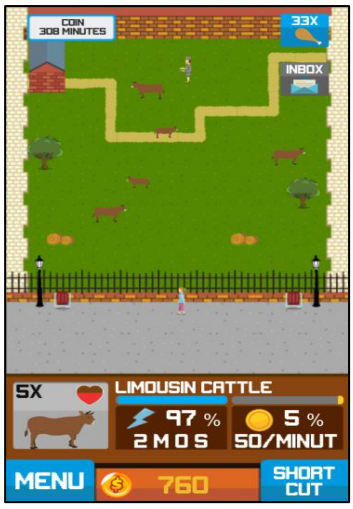

Figure 4. Animal display

Figure 5 shows the interface of the scene with the type of rescue common animals, with the results of Fisher-yates shuffle algorithm implementation to perform animal photos and answer randomization. The display contains a photo of an animal that has been scrambled and there are four choices of answers. In this type of rescue, players are required to guess the name of the animal.

Figure 6 shows the display with a rare type rescue, and the results of Fisher-Yates algorithm to do the randomization placement pattern to look for. The scene showing the number of attempt that can be performed, photos of animals, animal pattern to look for in the box 4 x 4, names of animals with a 4 x 4 box in it already contains patterns of animals, coin, and zonk. The player must open the box one-by-one until he

can find a pattern to do the animals rescue. Figure 7 shows the look of the mini game scene. In the mini-game, the player can collect coin as much as possible to increase his coin besides the coin which was produced by the animals he has.

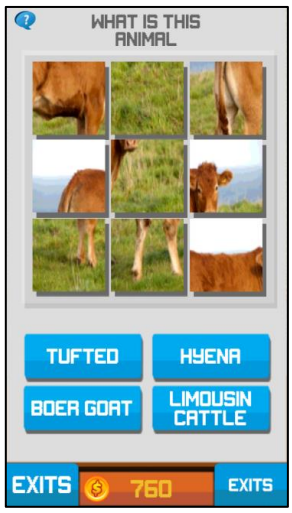

Figure 5. Rescue common type display

Figure 6. Rescue rare type display

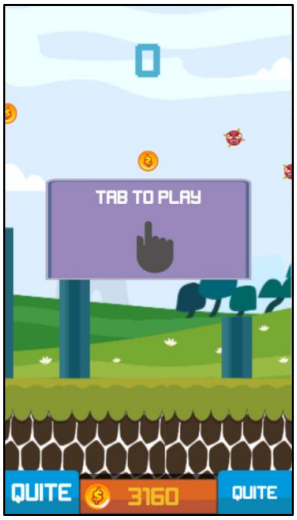

Figure 7. Mini Game display

5.1. Fisher-Yates shuffle

In this test, we will see if Fisher-Yates algorithm can generate a permutation by likely almost the same each time. From Table 2, the average occurrence of 500 times, 1,000 times, and 10,000 times randomization is ± 25%. There is no significant difference in the percentage of occurrence for each animal. Therefore, we can conclude that the randomization experiment as much as 500 times, 1,000 times, and 10,000 times not affect to much the occurrence percentage of animals that were randomized.

Table 2. Percentage of Animals Occurrences in 500, 1,000, and 10,000 times randomization

Animal Name	Percentage Occurrences	Number of Randomization
Kangoroo	24.6%	500 Times
Shelduck	25.6%	
Echidnas	24.8%	
Lyrebird	25%	
Kangoroo	24.2%	1,000 Times
Shelduck	24.5%	
Echidnas	25.7%	
Lyrebird	25.6%	
Kangoroo	25.24%	10,000 Times
Shelduck	24.85%	
Echidnas	25.24%	
Lyrebird	24.67%	

Figure 8 shows the percentage occurrence results from three variants of randomization, where we can see the Red Line is almost straight. This proves that the Fisher-Yates algorithm could generate permutations which giving almost the same possibility for each shuffling time without being influenced by the number of randomization done.

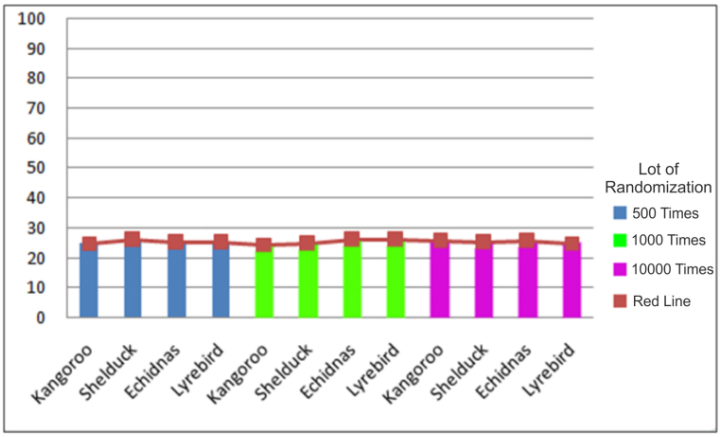

Figure 8. Image randomization results graph for 500, 1,000, and 10,000 times

5.2. ARCS scores

To know the acceptance level of Zoo Simulator and its effect on children learning phase, a survey was conducted using ARCS questionnaire. It has been used by many researchers, such as Malik [22] who used ARCS to overcome non completion rate of students in distance education, and Feng and Tuan [23] who used ARCS model to promote 11th graders' motivation in learning chemistry. Hwang et al. [24] also stated that due to its nature to provide challenging tasks, to encourage different levels of interaction, and to provide enjoyable multimedia and instant feedback, computer games have the potential to provide students with deep and meaningful learning experiences.

In this research, a total of 32 participants, who are kids with age ranges from 5 – 8 years old, were gathered at children playgrounds and malls. We used three devices on the evaluation phase, i.e. Samsung Galaxy Mega 6.3, Samsung Grand Prime, and Xiaomi Redmi 3 Pro. On this phase, we also conducted experiments to know the children learning interest using textbook and using game, i.e. the Zoo Simulator, and therefore two types of questionnaires were given to each participant.

Based on the calculation of the first questionnaire to know the children learning interest using textbook, we get an ARCS score of 2.74, which was quite good. Therefore we can conclude that textbook usage is quite liked by the children to learn animals' introduction. Furthermore, based on the calculation of the second questionnaire to know the children learning interest using game (Zoo Simulator), we get a score of 4.18 out of 5. It means that the game usage is liked by the children to learn animals' introduction. Figure 9 shows a result graph from the final counting of ARCS questionnaire regarding the animal introduction using textbook and game (Zoo Simulator) method. It can be concluded that the introduction method using the Zoo Simulator is more exciting the children's interest. This findings in line with other results from other researchers, as we can see on the works of Prins et al. [25], Rosas et al. [26], and Bai et al. [27].

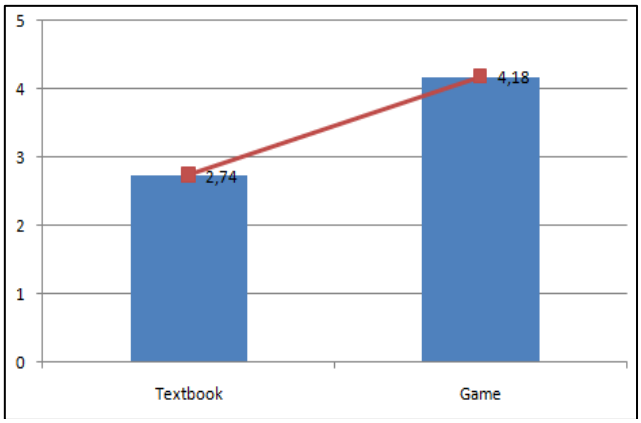

Figure 9. Graphic comparison between Game and Textbook method

6. CONCLUSION

Based on the research that has been done, we can conclude that Zoo Simulator as a media of animals introduction using Fisher-Yates shuffle algorithm has been successfully designed and built using Unity3D. The game built has a rescue feature with two different puzzle types, notification feature to remind players that there is a new incoming message, food button that will make it easier to cast in the animal's cage that are hungry to be fed, mini games feature that can be used to get additional coins, menu credit which will feature all individuals associated with architecture of the game, and animal info feature that will display a brief information of animals with its picture. The use of game method has been shown to increase interest in children learning phase compare to textbook method. There is an increasement from 2.74 to 4.18 after game method implemented based on ARCS interest measurement score.

There are also some suggestions for future researches, i.e. performance parts can be enhanced, so that the lag caused by the collider on the moving object can be reduced. Moreover, satisfaction factor on the questionnaire on the measurement of interest using the game get the smallest value compared to the other factors. These factors related to satisfaction, so the addition of challenge and difficulty elements in games can be considered. The award grant to the player also can give satisfaction and motivation in order to keep playing.

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