Kotak Edu: An Educational Augmented Reality Game for Early Childhood

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Abstract. Games are a part of children's development, but there are still a few developers who make games for early childhood ages. The purpose of this research is to create an educational game for early childhood age in order to enhance early childhood knowledge of animal shape and literacy in a relaxed and fun way with augmented reality features. This augmented reality game purpose is media for parents to teach their children while playing. The Scrum method is used in developing this game. The evaluation of this experiment was been done using testing and survey with 30 parents using game experience questionnaire (GEQ) and comparison to similar game. The survey result show that this game is suitable for the parents and childhood children and compared to others game, Kotak Edu had augmented reality as advantage.

1. Introduction
Nowadays, game is being studied as teaching and learning tools[1]. Teaching using games can increase children's enthusiasm, collaboration and motivation[2]. In addition, games are an option for developing learning media in schools for formal learning and at home[3]. Many games have been made to assist in formal learning, but there are still a few games for children that reach early childhood[4][5].

Early childhood education[6] is implemented from the age of 0-8 years. It is at this time that children's brain development reaches its peak. During this stage, children are greatly influenced by the environment and the people around them. Early childhood education is more than just preparation for primary school. Early childhood education aims to develop children's social, emotional, cognitive and physical needs[7]. Early childhood education is one of the best ways that can be done to prepare children for the future.

Many types of media can be taken to share information, one type of media that can be used is games. The use of simulations and digital games in the learning and assessment process is expected to increase in the next few years. Many predictions state that technology will bring good changes to the world of education. Through a game, children can undergo teaching and learning activities in a relaxed and fun way. Games will also improve students' skills through the playing process, such as verbal, visual, kinetic skills and other game-based activities. Augmented Reality[9] technology has been used for learning media[10]. Previous research has found that augmented reality will be beneficial for early childhood education because it will help the student to imagine the real situation[11]. The enthusiasm that is creating within game collaboration also increase learning speed and effectiveness[12][13].

This paper discusses game development methods to acquire augmented reality into educational game for children which will helps parents educating their children in a fun method. The game results will then be tested based on two parameters, namely user responses and the comparison of the game with other similar games. By doing these two analyses, it is hoped that this game can be in accordance
with user goals and easy to use. Comparison with other games aims to see the advantages of this game and provide a unique selling point for this game.

2. Research Methodology

The game development method used in working on this project is the Scrum methodology[14][15]. Scrum is an agile approach to developing innovative products and services[16]. Scrum has a basic response to a situation quickly and positively which allows for software adaptation. The advantage of this methodology is the flexibility in sharing what features are important and given a priority scale, so that the team can solve complex problems and develop important features first[17]. The user interface is designed to make the user easy to understand game[18].

The testing method uses two methods, namely alpha testing and black box testing. Alpha testing [19] is to test one by one for everyone, if you develop a software that will be used by many people. Therefore, alpha testing is performed by a representative group of users. Black box testing [20] or also known as behavioural testing or functional testing, focuses on the functional requirements of a software. Black-box testing tries to find errors in the following categories such as wrong or missing function, interface or interface error, errors in data structures or external database access, behaviour or performance errors and initialization and termination errors.

The evaluation method uses data from the questions given to the players. The evaluation method used is divided into two such as evaluation of user needs and game evaluation. The applications used to develop the Edu Box game are Unity3D as a game engine [21][22], blender [23] for making 3D modelling and FL Studio [24] as the manufacture of BGM and SFX.

Kotak Edu is a game created to provide experience to users who want to experience augmented reality. This Edu Box game is not only made for simulation, this game is also given a trophy feature if it succeeds in completing the challenges for users or players who want to experience the challenge.

The features which provided Camera or AR mode is a feature in the Edu Box, where this feature is started by pressing the camera button that has been provided, in this feature the user or player will be given several tutorials and explanations about how to use AR first, then the player can start camera mode to be directed to an existing educational book, then the player will be given instructions to do what activity. Trophy is an achievement for completing a word, finding pairs of animals, drawing plants, letters and numbers (with AR features). Gallery is a feature where players can see photos of animals that have been obtained from AR features obtained using a smartphone camera, for example, pictures of animals, plants, letters and numbers.

AR mode is the main mode in this game, where in this mode the player will be shown an image along with a description then the image will be matched with the image in the surrounding room. For example, on the screen a lion is displayed (figure 3), then the user must look for the lion around him and point the camera at the lion's shape. If the camera can capture the same shape, a 3d image will appear on the screen. At this stage parents play a role in providing explanations and coughing children to find the appropriate shape. In this AR mode, the form you are looking for can be selected, namely numbers, animals and means of transportation. By facilitating the user with visual content, the user will be more stimulated and better understand the physical form of the surrounding objects.

Figure 1. Game development method
3. Result and Analysis

In this research, we use two parameters as game result analysis which are user experience and game comparison to similar game.

3.1. User Experience

Evaluation of user experience uses the principle of five measurable human factor which are time to learn, speed of performance, speed of performance, rate of error by users, retention over time and subjective satisfaction [25]. This evaluation parameter is converted into questions of questionnaire. The questionnaire data was taken at alpha testing stage from 30 respondents. The respondents are parent within age range between 26 and 30 years old. The questionnaire answer is range from 1 to 4 where 1 represent very disagree while 4 represent very agree. The sample of questionnaire and result can be seen at figure 5.

From the questionnaire result at figure 3, the average player answered that the game is easy to understand. While the user interface question represented by question number 1, 2 and 8. Based on questions number 5, it can be concluded that the Edu Box game doesn't take long to play and understand it. It can be concluded that players can solve problems quickly. Based on question number 3 and 5, we can say that players already understand the features provided by the Edu Box game and are also fast in solving problems which means there are fewer errors in doing tasks. Based on the results of questions 1 and 3, the average player answers the user interface is easy to understand and easy to remember. Based on the results of question number 9, the average player answers satisfied after playing the Edu Box game. It can be concluded that players like and feel satisfied with the features provided by the Edu Box game.
3.2. Comparison to other game

This game has the Educational Game genre, AR with the theme of Education. The target users of this game are early childhood and parents who have children at an early age so that parents can teach early childhood using AR (Augmented Reality) technology and gain experience in using this game application. This game is an educational game that aims to introduce and teach the alphabet, from how to write lowercase and uppercase letters, as well as introducing numbers 1 to 10. The main feature used in this game is Augmented Reality (AR). With Augmented Reality users can see objects that don't exist in the real world or only on the device used by the player. Augmented Reality used in this game can add to the user experience of the players. This game also has several features, namely image, sound, and video features which are used as informative media and displays for players. The unique thing in this game is where parents and children can use AR with gadgets and find answers through this application. Table 1 shows comparison between Kotak Edu and two other educational games which are Letter School and Game Edukasi Anak Lengkap. Kotak Edu has the selling point in Augmented reality compared to the others game and it already covered most of the features from other game.

| Table 1. Comparison Kotak Edu’s features to others educational game |
|-----------------------------------------------|
| **Name** | Letter School [26] | Game Edukasi Anak Lengkap [27] | Kotak Edu |
| Platform | Android, iOS | Android | Android |
| Language | English | Indonesia, English | Indonesia, English |
| Player Mode | Single Player | Single Player | Single Player |
| Advantage | Has a very interactive and educational game in writing letters and numbers | • It has sound and image features that can explain various kinds of animals, fruits, numbers, letters, shapes, colours, musical instruments, objects in the house and transportation. • Can train children's memory. • Can train children's creativity when learning to colour. | • Features interactive mini games using AR. • Has a video explaining how to write numbers and letters. |
| Disadvantage | No augmenter reality features | • The pictures or how to play are less interactive, such as just listening to a word and then choosing an image according to the game theme that has been selected. • The game does not have an AR feature. | This game does not have a feature to write numbers and letters. |

4. Conclusion

We presented Kotak Edu, an educational game that teaches children to identify 3D animal shape and help to increase literacy understanding. This game can facilitate parent to study and have fun with their children. In the future, we plan to improve the game’s difficulty model by adding variations in learning English in terms of numbers, letters and animals for early childhood, added more varied and interactive mini games for early childhood and adding the Augmented Reality feature without having...
to use the target scan image, for example, it can bring up a 3D model according to how big the user's room is. User understanding is also matter to our experiment so in our next work we will compare the general understanding of children with our game and without the game.

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