DEVELOPING THE INTERACTIVE MAGIC AR BOOKS WITH GAMIFICATION FOR PROMOTE STORY BOOK

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Abstract

Children today tend to be more interested in playing with mobile phones than reading storybooks. The Interesting fairy tales from legends and traditional children's stories tend to be in the form of storybooks. And parents in the past often read fairy tales to theirchildren. However, in modern times, each of them is busy with their mobile phone. Therefore,there is a need for a solution so children can beinterested in reading fairy tale books without reducing the pleasure of playing games. The purpose of this research is to develop more interactive storybooks with Augmented Reality technology. The research method used isexperimental research which starts from collecting data on needs through questionnaires and interviews with related parties, then analyzes and designs and manufactures prototypes which will be evaluated by usability testing and heuristic evaluation. From previous research, Augmented Reality technology has been widely applied in learning material. in schools and universities and also applied to the introductionof museums. From the storybooks themselves, there are already some who have implemented Augmented Reality or Gamification in applications. However, there is still no interaction between the user and the storybook. Therefore, this study develops an AR BOOK application where users can read storybooks while playing with Augmented Reality technology. The evaluation results show that the AR Book application can attract users to read stories from the application and users areentertained by this AR Book application. So it can be concluded that the addition of Augmented Reality and Gamification technology can attract the attention of users to read storybooks in a different way. For further development, traditional stories can be developed so that they can be better known by the younger generation.

Keywords: Augmented Reality, Gamification,Heuristic Usability Evaluation ,Magic AR Book,

INTRODUCTION

Today's children prefer to use smartphones or tablets to view videos or play games. Children prefer to play games on smartphones than read story books. In ancient times, parents often read fairy tales from story books to their children before going to bed. However, nowadays it is rarely found due to the busyness of parents, as well as children's preferences for playing gadgets. Many fairy tales are rarely interested in children. Children prefer cartoons or videos from existing channels. To attract children's attention to reading story books and educational books is not easy. Many studies have been conducted to find alternative methods to increase children's interest and increase children's understanding of learning material. One of them is the use of Augmented Reality technology which is

currently being developed. According to Elmqaddem The learning method for students in the 21st century is to apply Augmented Reality (AR) and Virtual Reality (VR) technology in education [1]. Study Literature conducted by Chen et al who conducted a survey on papers from 2011-2016 showed that many studies used the Augmented Reality method in learning both in the field of science and social science [2]. Augmented Reality technology has been widely accepted in the world of education as a means of learning [3]. Research related to Augmented Reality in Education is mostly carried out on children at the elementary school level [4]. Altinpulluk stated positive effects such as increased learning motivation from the application of Augmented Reality technology in education such as Human-Computer Interaction, Robotics and Remote Laboratory Systems[5]. Research related to the combination of Augmented Reality technology with Mobile technology will be increasingly in the coming year [6], [7]. Apart from education, AR technology can also be used for tourist purposes in museums. Rodrigues et al implementing AR technology in museums using the Adaptive Card UI. This helps visitors to explore the museum in an interesting way[8].

The application of Augmented Reality in picture books such as textbooks on bacteria was carried out by Hung et al which offers a different and fun learning experience for 5th graders of elementary school [9]. Picture books that apply AR technology enhance learning experiences and understanding for children aged 5-6 years [10], [11]. Danaei et al compared the level of understanding of children who read printed story books and story books using AR technology and the results showed that the children's level of understanding of stories in AR story books was higher than children who read ordinary story books[12].

The relationship between parents and children can also be improved through story books that use AR. Cheng et al conducted a study which showed that the interaction between parents and children increased through the use of share story books using AR [13][14][15]. Through the use of AR technology, it can help the publishing industry in producing interactive story books using AR technology. Children are interested in using interactive story books that use a combination of audio, video and 3D objects [16]. To fulfill children's interest in playing games, the researchers suggest that apart from using AR technology in interactive story books, they also apply gamification in the story books. As we know, the world of education has also implemented gamification in learning and the results show children's interest in learning [17]. An example of gamification in learning that has been carried out by researchers is edutronics, which introduces electronic products through games [18]. While the example of gamification in history lessons about ancient kingdoms in the archipelago

[19]. Or BallonShooter which is a gaming application that teaches children how to count and recognize colors [20]. There are also researchers who combine chatbot with gamification to teach children how to live healthy [21]. Rodriquez et al have conducted an evaluation regarding the effect of gamification on the level of understanding of children related to culture [22]. Through the Dzongka application, children are taught to learn about English through the Bhutanese language [23]. This shows that gamification has a positive influence on children in understanding a certain material or topic. Hammady et al combined augmented reality with games to attract visitors to the museum [24]. In addition, Mesároš et al used a combination of Augmented Reality technology and games to become a virtual tour to introduce tourism objects in Slovakia [25].

The state of the art related to research related to digital storytelling books can be seen in the following explanation. Gironacci et al developed collaborative storytelling with a combination of Augmented Reality and Gamification [26]. The technique developed does not apply interaction with users. Meanwhile, researchers from the Philippines developed GoonAR, which is a children's story book in two languages, namely English and Filipino [27]. However, this application only applies AR technology without using gamification. Alhumaidan et al developed a collaborative augmented reality book based on the primary school textbook [28]. Nazaruddin

and Efendi (2018) developed a book using Pop- Up AR to increase focus and object recognition for children suffering from autism [29]. From the results of the existing state of the art, there are still advantages and disadvantages. Therefore, the authors propose a method that combines AR technology that has interactive design with users who are generally children and adds a mini-game in the digital storybook in order to increase interaction with children. The story developed is a children's story that contains moral that children can apply in their daily lives.

METHODS

The research methodology to be used is experimental research. Each stage will be explained as follow:

a. Discovering user needs

The author conducted a literature study related to similar research. Then make comparisons with existing similar applications. Next, conduct a survey questionnaire on children's parents and elementary school teachers to find out the needs of their children and the obstacles faced by parents and teachers. The survey data collected from random elementary school in Jakarta. The result of the survey mostly are quantitative data like the frequency of reading storytelling to children, which category story that mostly like by children, etc.

b. Perform analysis on the data collected. Due to quantitative data, so we are using the mean, the median also the average value from the survey result. From the survey results, a needs analysis was carried out related to the features that will be developed on the prototype.

c. Doing interaction design and game play at this design stage, the main characters are designed to be displayed in the story. Then the mini game design will be used in this digital storybook.

d. Prototype Development

The prototype is developed according to the features required by the user.

e. Evaluation with potential users

To determine the suitability of applications made with user needs, a usability evaluation and a usability heuristic were carried out [30].

The usability testing will test with four tasks:

1. Scan the QR Code in the Story
2. Play the Drag and Drop minigame
3. Play the coloring minigame
4. Change the setting in application

The experiment scenario will follow these steps:

1. Each respondent will get a Story Book combined with QR Code.
2. Then, they try the prototype using the given task.
3. After that, they fill the questionnaire about how the satisfy or ease to use the prototype.

RESULT AND DISCUSSION

We are discovering the user requirement with 120 respondents with category as parent or kindergarten teacher. From the survey we have found that more than 60% very rare telling the story with their kids due too their parents are busy and their children not interest reading the storybook.

For the story that will be used on the Magic AR Book, more than 80% respondent like The Hare and The Tortoise story. About the AR Technology only 32% respondent has experience using this kind technology and more than 78% have heard about this AR. For the mini game implemented in the Apps, more than 75% like the coloring game and 49% like to drag and drop. So, the mini game implemented on the apps using the game play based on survey.

From the results of literature studies, user needs analysis, and comparative analysis of similar applications, an application with the following features is designed (Fig 1). This main feature based on Fig. 1 is playing. In feature playing, the user can see animation, also the gamification using AR Technology. The user can interaction with the Magic Book (Fig 2). The player can scan each page to follow the story. There are two mini games such as Drag and Drop (Fig 3), this kind of game will play interact the apps with the magic book. And the last mini games are coloring cakes (Fig 4). The story in the Magic Book is related with competition between the Hare and

The Tortoise. The Hare is confident can win the competition with the Tortoise but at the end thewinner is not the Hare. This story has the moral meaning that you cannot wait to do something,just focus what you want to do, do not interruptwith other thing.
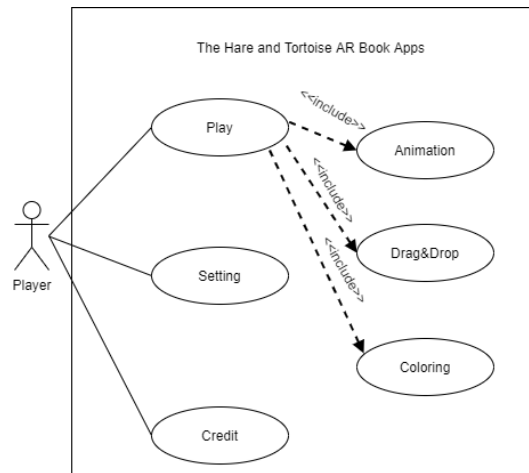

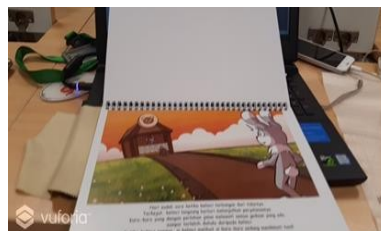**Figure 1. Use case of Hare and Tortoise AR Book**

Figure 2. The Magic AR Book

Figure 3. The Drag and Drop Minigame

Figure 4. The Cake Coloring Mini Game

Based on the figure 5 this AR Book has two main characters: The Hare and The Tortoise. The Hare is a rabbit, he can run faster but he easily attracts to playing. The Tortoise is a turtle that very slowly when walking, but he still focusses on what to achieve and still walking, ignore any interesting activity like playing or buying snack, and finally he can win the competition with the Hare. The user journey from AR Book can be seen in Figure 6. It starts from pressing the Playing (Main) button then the application will scan the marker on the Magic Book. The user can have three choices, they can directly play or do some configuration on Setting Button (Pengaturan).

At the last button display the credits information. If the user choose the Playing Button then open the Magic Book, , and scan the marker on the Magic Book page by page. This kind Magic Book can be played by the children with their parents. But also played by anyone that interested using this Magic Book.
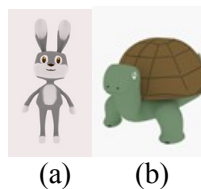

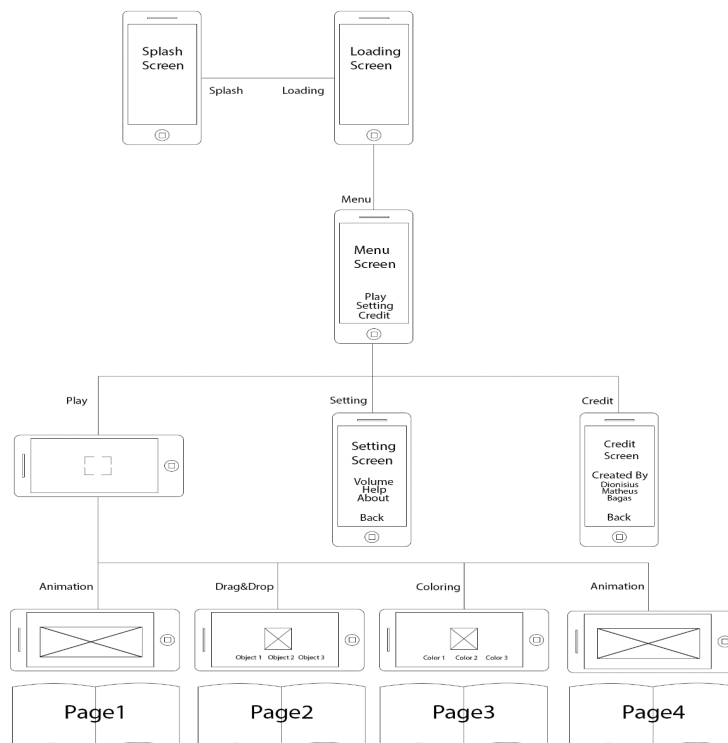(a)   (b)

Figure 5. (a) The Hare (b) The Tortoise

Figure 6. The User Journey of AR Book

Table 1. List of Usability Question

No	Question
Q1	Was the application in overall easy enough to understand?
Q2	Do you have problem when navigating the Magic AR Book?
Q3	Do you enjoy playing the mini game inside the application?
Q4	How easy to understand how to play the mini game?
Q5	Do you remember how to use the AR feature?
Q6	Do you find any error when using this application?
Q7	Do you satisfy this apps?

The question has been asked on usability evaluation such as (Table 1). The purpose of the question Q1, Q4, and Q5 to measure the ease of use and learning, the purpose of the question Q2, and Q6 to evaluate the rate of error and user interface problem, and the question Q3 and Q7 to measure the satisfaction aspect of usability. Based on usability evaluation, we have shared this application and tested by 31 respondents. The evaluation result that mentions there are more than 85% can understand how to use this apps and the magic books. There are more than 85% can easily navigate the magic book page by page. Also, more than 86% can still remember how to use the apps after demo application. It is around more than 86% satisfied with the application. They like the implementation Augmented Reality on the application. So, we can conclude that the Magic AR book and The Hare and The Tortoise AR Application can satisfy the user also they are enjoying with new experience reading interactive storybook with Augmented Reality and gamification.

Based on Heuristic Usability Evaluation [30], we can conclude that:

a. Visibility of the UI in the application and the Magic Book is very simple cause the general icon or interaction been used in the application.

b. Match between the real world with system: the story is related with our daily life also the activity is same with our daily life

c. User Control and Freedom: user can started scan with random page, and the user has given choices to choose the feature on the application

d. Consistency and Standard: the color, the icon also the button has consistency in each feature and each page

e. Error Prevention: There are message error if the user clicks the button wrongly

f. Recognition than recall: the interaction or menu on the application is similar with common application so the user can

easily recognize again when reading the Magic AR Book.

g. Flexibility and efficient to use: To starting using the marker, user only click one button (Playing Button) and the AR will started.

h. Aesthetic and Minimalist Design : The design on the Magic AR book is simple and using the colorful design that can attract children or anyone to read the Magic AR Book.

i. Help user to recognize : The user can easily play the minigame also using the AR with the icon that easy to recognize.

j. Skills : There is no need to expert to play this application . Anyone can easily use this Magic AR Book and the Apps.

k. Pleasurable and respectful interaction : Based on the evaluation with user, they were enjoy and have fun with this new experience reading the storybook.

We can conclude that this Magic AR Book and its AR Application has good usability. The user can efficiently and effectively use the featureon the apps. Also, the user satisfies with the new experience reading story book with playing mini games and interact with Augmented Reality Technology.

CONCLUSION AND FUTURE WORK

The implementation Augmented Reality technology and mini games on this application also the interactive interaction in the Magic ARBook can attract children to read the storybook. Also with combination animation, image, text also the audio in the Magic AR book and the ARapps can help user understand the story and easily to play the minigame inside the Magic AR Book. The user is not only for children but also for public whose interest with the story. The user is satisfied with the interface in The Magic AR Book also enjoyable playing the minigame inside the apps. Through this apps, they enjoy reading the AR Magic Story Book. For the future research, it can be implemented forfable story also can add some new interface like natural user interface or gesture user interface.

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