Augmented Reality-based Educational Game: Shape and Color for Kids

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Abstract. Augmented Reality (AR)-based educational game "shape and color for kids" is developed to make it easier for children to learn English. This educational game contains combined content of nouns (flat shapes) and adjectives (colors) that are run on Android-based smartphones, so they can be played anywhere and anytime. This educational game with AR features is a technology that combines the virtual world and the real world so that it seems as if the information obtained is interactive and live-like. The research method used in this study is Research and Development (R&D). The results shows that the AR-based educational game "Shape and color for Kids" was considered very good by media experts with a score of 85.70%. The results of the validation by material experts showed a score of 88.65% which means very good. The results of the trial test on 4 preschoolers also showed very good results with a score of 90.35%. Therefore, based on the score obtained, it shows that the AR-based educational game "Shape and color for Kids" is feasible and can be used as learning media.

Keywords: Educational Game; Shape and Color; Augmented Reality

1 Introduction

English is one of the most widely spoken languages in the world. English occupies the second position after Chinese with around 508 million users [1]. The need for learning English has increased significantly with the existence of the industrial revolution 4.0 and the ease of communication with other countries. According to Lenneberg cited by Sinaga et.al, individuals have an important period to be able to master the language called the “critical period” easily and quickly when the individual has not yet entered puberty [2]. Therefore, language learning should be introduced to children at that time. Learning English can be initiated by introducing basic vocabulary such as nouns, adjectives, pronouns, and others. Introducing basic vocabulary first so that when it increases into sentences, children already have basic word knowledge. In Indonesia, English is not a mother tongue, so parents and teachers must be smart in teaching it. According to Iriance, Indonesia, Vietnam, Cambodia, Laos, and Thailand have scores of 38.45 – 54.06 with a very low category in English. This score is very far when compared to Singapore, Malaysia, and the Philippines whose scores are 60.33 – 63.52 [3]. With the category obtained by Indonesia, English is important to be taught from an early age.

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English material covers all aspects of skills starting from reading, speaking, listening and writing. Studying all aspects aims to improve English language skills as a whole. Teaching English language material can be started at a young age although the content must be age-appropriate. The basic material that children need to master first is vocabulary which is common around them. The English material that can be taught first is to combine two types of words, nouns and adjectives. Merging adjectives; color with nouns, namely flat shapes which are the initial form of building space and objects around will make children experience increased thinking skills. For example, an adjective white combined with a noun in a round shape can be described as a sphere. Exemplifying English with objects that are around children makes children's imaginations and the process of relating them to their daily experiences better ,so their understanding of English will be better too.

Teaching children to speak English should not be difficult because the material being taught is simple, but what is difficult is how to teach it. In the implementation of teaching, the lack of variety of methods or media used to teach English makes the delivery difficult. Parents and teachers are required to be creative and unique in conveying material to children, so they are interested in learning English. The use of media as an intermediary for learning English has many types, such as animations, story books, posters, and others. The packaging of learning media will be more interesting if the material is not only delivered in one direction but also there is an interaction side. Learning media such as educational games can be used to learn English because there is not only material but also games that can be played. One of the technologies that can be combined to ease learning English is augmented reality (AR)-based mobile technology. AR technology is a concept that combines the virtual world with the real world so that it seems as if the information obtained is interactive and live-like. The application of AR requires an example of the target image, the type of camera used and the distance from the camera to the image. The technology in the multimedia field that is currently developing rapidly is Augmented Reality (AR). Augmented Reality is a technology that combines the virtual world with the real world so that users can seem to interact directly with objects displayed using mobile devices. AR technology is currently starting to penetrate into various fields including education. Tonni Hidayat states that the use of AR as a tool to educate children will provide a new perspective on the current learning media, not only using real objects but also being able to use virtual objects [4]. In addition, the value added of AR-based media is that it makes it easier to deliver and makes information more interesting. In line with Tonni Hidayat, research conducted by Ilmawan Mustaqim on the use of AR as a learning medium points out that the use of educational media using AR can stimulate students' mindsets to think critically about certain problems and events [5]. In addition, Ilmawan Mustaqim also mentions that Augmented Reality learning media can visualize abstract concepts for understanding and the structure of an object model enabling AR as a more effective medium in accordance with the objectives of the learning media.

The use of AR technology is not the only thing that is highlighted in this "Shape and Color for Kids" educational game. However, there is also Android technology as an operating system on smartphones where this educational game can be played. Android-based mobile technology makes it easy for parents and teachers to teach the material in this educational game anywhere and anytime. Android is a Linux-based operating system that is used on various devices such as smartphones [6] where this operating system controls about 90% of the world's market. Developing an educational game "Shape and Color for Kids" aims to teach English through learning media in the form of educational games. By learning through this educational game, children play while learning so that children are more ready to accept deeper English concepts such as combining two words, nouns (flat shape) and adjectives

(colors). This educational game contains not only AR applications installed on Android smartphones but is also equipped with colored flat shapes that are used as projection media to create 3-dimensional (3D) objects. In addition, in this educational game there is also a play mode that allows children to understand the material through the games in the game application, so learning English becomes easier and more interesting for children.

2 Methodology

This study employs the Research and Development (R&D) method that aims to produce AR-based educational game "Shape and Color for Kids" for children. The development stages used for this development research refer to Sugiyono's development stages which consist of 10 steps [7]: (a) Potential and problems, (b) Data collection, (c) Product design, (d) Product validation, (e) Design revision, (f) Product trial, (g) Product revision, (h) Trial usage, (i) Final product revision, (j) Mass production. The implementation of the research used in the development of this research was adopted from the stages of development of Sugiyono. The stages of development research are as follows:

Fig. 1. Research Stages

a) Potential and Problem
Learning English is something that needs to be taught from an early age considering that English is one of the most widely used languages in the world. By teaching vocabulary first, children will learn English faster at a higher level. Learning while playing is the most preferred learning phase by children, so the use of learning media in the form of educational games makes children more interested in learning English.
b) Data Collection
The writers collect the materials related to the design of learning media that will be developed.
c) Product Design
   1) Create flowcharts and storyboards. A flowchart is made as an illustration of the flow of the program. After making a flowchart, the next step is to make a storyboard which is used as a guide to facilitate the development stage of learning media.
   2) Product Development. Storyboards that have been made is ready to be developed into a learning media. It starts from making flashcard designs, producing pictures that will be used in learning media, and making programs starting from the main tools, namely Unity and Vuforia SDK.
d) Product Validation
Product validation is conducted by making a questionnaire in the form of assessment questions that are carried out by two validators: media experts and material experts.
e) Design Revision
Design revisions or improvements are made based on suggestions and input from the two validators.

f) Product Testing

The product testing refers to the development stage of Sugiyono as many as 2 to 4 children in the pre-operational stage in the age range of 2 to 7 years [7].

Data collection techniques used in this study were observation and questionnaires or questionnaires filled out by the child's parents. While the data analysis technique used in this research is to use descriptive analysis techniques. There are 3 instruments used in this study, namely instruments for media experts, material experts and instruments filled out by parents. The media expert instrument consists of several aspects, including: aspects of appearance, content, navigation and audio-visual. Meanwhile, in the expert instrument, the material aspects consist of material and learning. Instruments for parents consist of aspects of media, media operation and usability.

3 Results and Discussion

This study aims to produce AR-based learning media for educational games "shape and color for kids" which aims to facilitate learning English that combines educational games that contain combined content of nouns (flat shapes) and adjectives (colors) that are run on smartphones. with the Android operating system becomes interesting, creative and can be learned anywhere and anytime. The educational game "shape and color for kids" has an Augmented Reality feature that is used to project basic 3D objects into a real environment. Making educational game learning media consists of several stages, namely:

a) Product Design

The main product of this research is an Android-based application that utilizes Augmented Reality technology to display objects in the form of colors and flat shapes. Here is the application developed:

1) Application of Educational Game “Shape and Color for Kids”

This Shape and Color for Kids educational game application is the main product resulting from this research. This application contains pictures of flat shapes and colors in English.

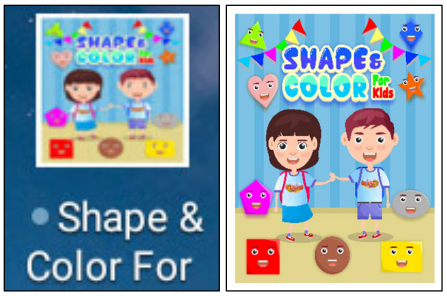

Fig. 2. Design of Application Icon and marker “Shape and Color *f*or Kids”

2) Media Flowcart

A flowchart is made as an illustration of the flow of the program. To run the program, it begins from the start button then it is proceed to the main page. On the main page there is a selection of material and game button menus. The material button contains material about shape and color, while the game button contains games that children can play freely. In the game there is a replay button to replay the game from the beginning.

On the material and game pages there is an exit button to end the program. The following is an overview of the flowchart of the developed media.

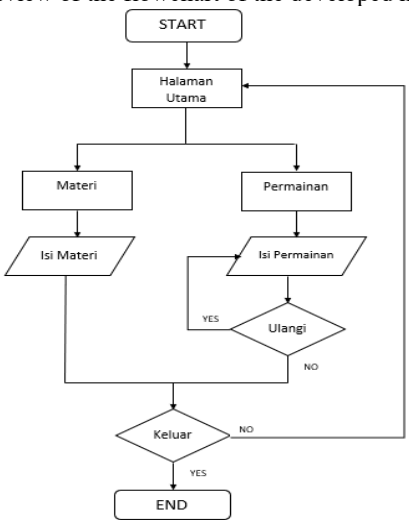

Fig. 3. Flowchart Media

b) Product Result

The product is an Android-based interactive learning media application that utilizes Augmented Reality technology to display 3D objects in the form of flat shapes and colors. This application is also equipped with image markers of various colored flat shapes that are used as projection media to bring up 3D objects. The first step to using this application is to install the application on each smartphone. The following is the look of the aplication.

1) Icon and Marker

The application icon image is the same as the Augmented Reality marker image. This Shape and Color for Kids icon image will appear on the smartphone screen after the installation process is carried out. Meanwhile, markers are printed on paper which will later be used to create 3D flat-shaped objects and their colors.

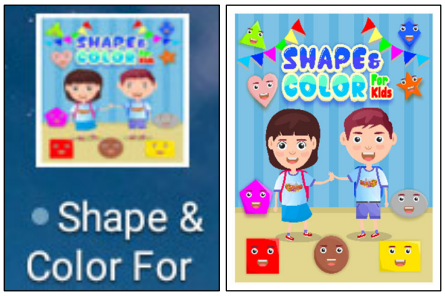

Fig. 4. Icon and Marker of "Shape & Color For Kids" Application

2) SplashScreen

The splashscreen display or the loading page display will appear a few moments after the icon is clicked before entering the Home menu which contains the media title "Shape & Color for Kids".

Fig. 5. SplashScreen

3) Home

The Home menu is the start page of the program, in which there are two main buttons, namely the Learn button and the Play button. In the Header section there is an Info button with the logo "!" and an exit button with an "X" logo containing information about the application and instructions for exiting the application.

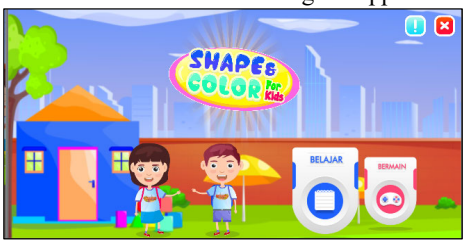

Fig. 6. Home Page

4) Icon *Belajar*

If you click the icon *Belajar* on Home page, learning mode options will appear, namely Normal Mode and AR (Augmented Reality) Mode. Both of these modes are available and they can all be used to learn about shapes and their colors in English.

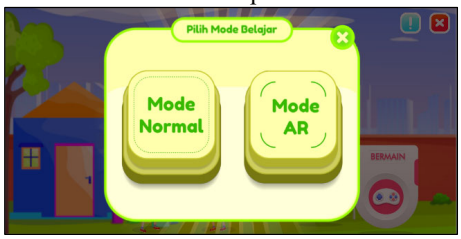

Fig. 7. Learning Mode Options

a) Normal Mode

In Normal Mode the learning process is carried out by displaying various kinds of flat shapes and colors and there is a descriptive text in English. Before learning in this normal mode, the user manual will appear first to make it easier for children to learn. Then to start learning, the cross (X) on the learning guide is clicked first and after that children can start learning about flat shapes and colors in English.

Fig. 8. The Manual of Normal Mode Learning

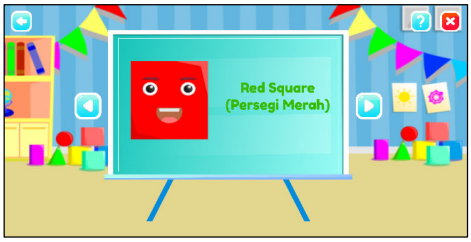

Fig. 9. Learning Process

b) AR Mode

In AR Mode, the learning process is carried out by displaying various basic shapes and colors in three-dimensional (3D) form and there is a descriptive text using Augmented Reality. Same as in Normal Mode. Manual for learning will appear first and then after that user will be directed to choose an object or basic shape that will be displayed with a marker that has been printed previously.

Fig. 10. The Instruction of AR Mode Learning

Fig. 11. Option of Basic Shapes

Scan result of 3D object marker for basic shape and color for example:

Fig. 12. Red Square and Blue Rhombus

5) Play Mode

On the Home page, in addition to the Learn button, there is a Play button which if you click the Play button, you will be directed to the guessing shape and color play page in English. Before playing, the instructions for playing will appear first. In the game process, if the answer is correct, correct feedback will appear. Moreover, if your answer is incorrect, incorrect feedback will appear. At the end of the game there is a Repeat button to repeat the game and a Home button to go to the start menu.

Fig. 13. The Instruction of Playing Game

Fig. 14. Guessing Game "Shape and Color"

Fig. 15. "Correct" Feedback

Fig. 16. "Incorrect" Feedback

Fig. 17. Game Ending

The existence of this play button makes this application not only focus on learning (only giving explanations) but also invites users in this case are kindergarten children to play because of the characteristics at the age of these children, they tend to prefer playing while learning.

6) Application Info

On the Home menu, in the header section, there is an Info button with the logo "!" which contains a brief description of the media and the holder.

Fig. 18. Media Information

7) Signing Out

If the user wants to exit the program, they can use the exit button with the "X" logo, and there is a confirmation popup.

Fig. 19. Signing Out Confirmation

c) Validation and Product Testing

At the product validation stage, referring to Sugiyono's development stage, it is carried out by asking for assessment from 1 material expert and 1 media expert. Material expert is a kindergarten teacher who at the time of selection was considered to be more familiar with the flat shapes and colors taught in the kindergarten curriculum. While media expert is IT education lecturer, especially in the field of learning media. In the material expert validation, a score of 85.70% was obtained. It means that it was in the very good category and received several suggestions for improvement that had been revised according to the suggestions. In the material expert validation, a score of 88. 65% was obtained. It means that it is also in the very good category. Thus, from the results of media validation, it shows that the educational game application Shape and Color for Kids is stated to be feasible as learning media used to study shapes and colors in English.

After product validation has been carried out and the media has also been revised, product testing is conducted on small group users; children at class B kindergarten. Referring to Sugiyono's development stage, the number of users in small groups is 2 up to 4 people. In this product trial, 4 children were taken accompanied by their parents. Considering the Covid-19 pandemic condition, learning was carried out at home with assistance from parents and also the use of smartphones as the main intermediary for this educational game. Of the 4 users, it obtained an average score of 90.35%. In average it is in the very good category. In addition to those categories, observations and interviews with parents showed that children are interested and enthusiastic in interacting with the Shape and Color for Kids educational game application because full-color media attracts their attention. It is easy to play since this application is run on Android on smartphones. Moreover, it makes the children more enthusiastic in using the educational game application Shape and Color for Kids. Thus, it can be concluded that the learning media of the educational game Shape and Color for Kids based on Android is very suitable to be used as a source of learning to form flat shapes and colors in English.

The results of this research and development show that learning media, especially educational games intended for children, can attract children's attention and interest. Because at the age of children, they prefer to play while learning. Similar research was conducted by SL Rahayu & F Fujiati with the result that states that the learning method for early childhood is learning while playing. Children will also find it easier to receive information in the form of multimedia, especially English material [8]. In addition to attracting children's interest and attention, this AR-based educational game "Shape and Color for Kids" also stimulates children's thinking skills because the material in this media is a combination of adjectives (colors) and nouns (flat shapes). Educational games as media that stimulate children's thinking skills are also produced by research that has been carried out by RA Rahman and D Tresnawati where in this study produced educational games designed to stimulate thinking power and also train children's concentration [9].

4 Conclusion

Based on the development research that has been carried out, it can be concluded that this development research resulted in an Augmented Reality-based educational game media "Shape and Color for Kids" helps children in learning English, especially learning nouns and adjectives. The learning media developed in this study is considered feasible and can be used as learning media while playing to introduce nouns and adjectives in English. The results of

the material expert validation show a score of 88.65% which means very good. Moreover, the results of the media expert's validation show a number of 85.70% which means very good and the results of product trials on 4 children obtain a score of 90.35% which means very good too. Therefore, this media is categorized and applicable.

References

[1] Hasan, R.A.: 10 Bahasa dengan Penutur Terbanyak di Dunia, Indonesia Urutan Berapa? (2019).https://www.liputan6.com/global/read/4063214/10-bahasa-dengan-penutur-terbanyak-di-dunia-indonesia-urutan-berapa.

[2] Sinaga, J.B., Manurung, S., Marpaung, J.E.: Bimbingan Belajar Bahasa Inggris Untuk Anak Usia Dini Di Kelurahan Buliang Rw 18. Minda Baharu. Vol. 1 (20), pp. 33-41. (2017).

[3] Iriance.: Bahasa Inggris Sebagai Bahasa Lingua Franca dan Posisi Kemampuan Bahasa Inggris Masyarakat Indonesia Diantara Anggota MEA. Prosiding Industrial Research Workshop and National Seminar. Vol. 9, pp. 776-783. (2018).

[4] Hidayat, T.: Penerapan Teknologi Augmented Reality Sebagai Model Media Edukasi Kesehatan Gigi Bagi Anak. Creative Information Technology Journal (Citec Journal). Vol. 2 (1), pp. 77-92. (2014).

[5] Mustaqim, I.: Pemanfaatan Augmented Reality Sebagai Media Pembelajaran. Jurnal Pendidikan Teknologi dan Kejuruan. 13 (2), pp. 174-182. (2016).

[6] Supardi, Y.: Belajar Coding Android Bagi Pemula, Jakarta: PT Elex Media Komputindo. (2015).

[7] Sugiyono.: Metode Penelitian Pendidikan Serta Pendekatan Kuantitatif, Kualitatif, serta R&D. Bandung, Alfabeta. (2019).

[8] S. L. Rahayu, F. Fujiati.: Penerapan Game Design Document Dalam Perancangan Game Edukasi yang Interaktif untuk Menarik Minat Siswa dalam Belajarn Bahasa Inggris. Jurnal Teknologi Informasi dan Ilmu Komputer (JITK). Vol. 5 (3), pp. 341-346. (2018).

[9] RA Rahman, D. Tresnawati.: Pengembangan Game Edukasi Pengenalan Nama Hewan Dan Habitatnya Dalam 3 Bahasa Sebagai Media Pembelajaran Berbasis Multimedia. Jurnal Algoritma. Vol. 13 (1), pp. 184-190. (2016).