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Augmented Reality Application for Children Pictorial Dictionary

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ABSTRACT

The main purpose of conducting this project is to develop an Augmented Reality application for Children Pictorial Dictionary for mobile devices. This application will allow the users, especially the children, to view a 3D model of an image in the pictorial dictionary by scanning the image. The users will also be able to interact with the model by rotating the model around, enabling the users to fully understand how the object looks like. The way on how to pronounce each of the names of the object scanned, along with the audio will also be provided in order to guide the children to pronounce the word correctly. ADDIE methodology will be applied in developing this application. The ADDIE methodology consists of five phases. That is, analyse, design, develop, implement, and evaluate. It is considered as a generic process traditionally used by training developers. This model is linear and sequential. In addition to that, questionnaires have been distributed among the students of UNISEL and also people outside mostly consisted of adults. The questionnaire is distributed via Google Form and the links are shared using WhatsApp. There are a total of 41 respondents that have answered the given questions and have successfully acquired data for developing the system. As A result, most of the respondents agreed that incorporating Augmented Reality in education will help tremendously in grabbing the children's interest in learning new things. In addition to that, the majority of the respondents agreed that it is suitable to apply Augmented Reality to pictorial dictionaries since the elements of multimedia such as, graphic, animation, text, audio will be able to keep the children's interest at peak level.

Keywords: *Augmented Reality, Pictorial Dictionary, Education*

INTRODUCTION

Augmented Reality (AR) is an emerging form of experience in which the real world is enhanced by computer-generated content which is tied to specific locations and/or activities (Yuen et al, 2011). AR also can generate perceptual information, occasionally numerous sensory modalities, including visual, auditory, haptic somatosensory and olfactory. There are three basic features that can be defined as an AR system: a combination of real and virtual world, real-time interaction, and accurate 3D registration of virtual and real objects. The overlapped sensory information can be an additive to the natural environment, or covering of the natural environment. AR is the latest technological advancement in the market that has succeeded in leaving an impact on the way users experience their surroundings. (Jung et al., 2016).

As computers increase in power and lessen in size, new mobile, wearable, and pervasive computing applications are rapidly becoming feasible, providing people access to online resources always and everywhere. This allows a new possibility in constructing new applications that are able to manipulate the users' environment context. Hypothetically,

information can be accessed when a mobile device scans the image or poster. In this modern era, researchers are continuing towards the goals of making mobile device more easily accessible and incorporating mobile resources in curricula (Mi et al, 2016)

Basic pictorial dictionary is made of paper and provides basic information, such as the name of the image provided and its translation. For example, a picture of an apple and its name in English with the translation in Malay. Whereas, augmented reality pictorial dictionaries with digital characteristics come in different formats and can run on mobile platforms. Augmented Reality pictorial dictionaries propose users all the essential information, such as words, images, pronunciations, audios, and so on.

PROBLEM STATEMENT

One of the problem statements is that the existing method of learning for children can be dull and non – interactive (Experts, 2019). Specifically, pre-school education system that heavily rely on books. Children will get uninterested in learning far quicker and will so lose motivation to learn new things.

In addition to that, children nowadays are native media literate, the consequence leads children to have an advanced expectation on the learning activities, which make them less interested in learning using traditional books. Parents in this current era, have started exposing their children to mobile devices at a very young age, as a consequence of that action, they have begun to develop familiarity in using mobile devices and have found them to be entertaining. They will expect more from the education system for something that can grab their attention.

Next, the existing education system does not make use of the abundance of ICT tools, and apps in pre-school education. Although there are plenty of mobile devices and computers that can be easily acquired by most educational institutions, they are still some that are unable to include ICT related tools in their teaching, specifically, in preschool education. Most of the children already know how to use the technology.

OBJECTIVES

- To develop a method of teaching that is engaging and interactive.
- To modernize the method of teaching for pre-school education.
- To make use of the available ICT tools and apps in pre-school education.

SCOPE OF STUDY

Teachers of preschool student from the age of three to four years old and parents of children from the age of three to four years old can purchase the pictorial dictionary at a bookstore. Users, including the children then will be able to scan the pictures in the dictionary via the augmented reality that will be available at Play Store for Android in order to view additional information. Users also can interact and choose different images to view or see translation of Malay language to English language at their own pace.

Developers will need to design every object in the pictorial dictionary. Developer also needs to include the information about the objects such as, the meaning, the pronunciation, and the voice sample for the pronunciation.

SIGNIFICANCE OF PROJECT

Augmented Reality in the education system is not extensively applied yet at the present time especially for preschool education. The significance of this project is that by using AR in education, it can help the users such as, the students, teachers, and parents to be further involved with the teaching.

Furthermore, by applying AR in the pictorial dictionary, this will help increase immersion and focus while learning. Children in this current era find studying the traditional way using books and flashcards is dull and boring. Moreover, most users in this modern day are very application literate, including most children. This application will make learning far more interesting and engaging for users.

In addition to that, this AR pictorial dictionary also will provide more in-depth information about an image. One scanned image will give the translation of its word, the pronunciation, a voice sample of how it was supposed to be pronounced, and a 3D model of the image.

CONSTRAINT AND CRITICAL ASSUMPTION

Constraint that commonly occurred with augmented reality is that functionality issues can happen during class sessions and this can halt the session until it is fixed. The lighting of the surrounding also plays a major role in using AR. If the surrounding is too bright or dark, the application may not be able to scan the images properly.

Critical Assumption that can happen during the project development is that some phone may not be able to support AR applications. Users may not be able to use the application or have to upgrade their phone. For AR to work, the image needs to be in pristine condition. Since the pictorial dictionary is for children, they might doodle on the image, crumpled the page or ripped page might occur.

LITERATURE REVIEW OR RESEARCH BACKGROUND

Augmented Reality

Augmented reality is a variation of Virtual Reality. Virtual reality technology functions by entirely allowing a user to be in a synthetic environment. While immersed, the user is completely unaware of their surroundings. On the other hand, Augmented reality allows the user to experience the synthetic objects that overlap with the real world while still being able to be completely aware of their surroundings. Research in theoretical learning in immersive virtual environments is a relatively young field but growing immensely. By including AR in learning experience, it can contribute to raising interest and motivation in students. Consequently,

augmented reality enhances reality rather than entirely replacing it. Preferably, it would seem as synthetic objects and real world coincide in the same space (Krevelen, 2010).

Augmented reality consists of three simple steps: Recognition, Tracking, and Mix. In recognition any image, object, face, a body or space is documented on which virtual object will be covered. During tracking real-time localization in space of the image, object face, a body or space is performed and finally media in the form of video, 3D, 2D, text, etc are overlaid over it (Amin and Govilkar, 2015).

In educational settings, augmented reality is still a budding area of implementation and study. Although great strides have been made in the robustness of the technology, best practices for its use in education are still being defined and redefined through designed-based research. Because the uses and affordances of educational augmented reality are still being explored, there is a design-based process that producers must go through to iteratively define how technologies get applied, what value-add they bring, and how to best harness their distinguishing features to improve learning (O'Shea and Elliott, 2016).

History

The chronologically AR development can be traced back to the beginning of the 90's, the Boing Corporation created the first prototype of augmented reality system for showing to employees how to set up a wiring tool. At the same time, Rosenberg and Feiner developed augmented reality assistance, showing that the operator's performance was enhanced by added virtual information on the fixture to repair. In 1993 Loomis and colleagues produced an AR GPS-based system for helping the blind in assisted navigation through adding spatial audio information. In 1993, Julie Martin developed "Dancing in Cyberspace," an AR theatre in which actors interacted with virtual objects in real time.

Few years later, they developed the first Mobile AR System (MARS) able to add virtual information about touristic buildings. Since then, several applications have been developed, such as, ARQuake is created by Thomas et al, a mobile AR video game was created by Wikitude in 2008, it can detect the user's location through the user's mobile camera, internet, and GPS could add information about the user's environments. In 2009, other AR applications, like AR toolkit and SiteLens have been developed in order to add virtual information to the physical user's surroundings. In 2011, Total Immersion developed D'Fusion, an AR system for designing projects. Finally, in 2013 and 015, Google developed Google Glass and Google HoloLens, and their usability has begun to test in several fields of application.

Types of Augmented Reality

a) Marker-based Augmented Reality
Uses physical-world symbols as an orientation point for computer graphics to be overlaid. In this system camera continuously snapshots the marked object and processes the image to estimate the position, orientation and movements of the visualization display with respect to the target object. To give an instance, a 2D printed marker is placed in front of a mobile device camera. The mobile device then construes this symbol to overlay an on-screen graphic as if it were directly on top of the marker in the related

world. The main problem of using marker-based augmented reality is that lighting and focus can affect the performance drastically (Amin and Govilkar, 2015).

b) Markerless Augmented Reality
Applies a combination of an electronic devices' accelerometer, compass and location data (GPS) to determine the position in the physical world, which way it is pointing and on which axis the device is operating. This location data can be compared to a database to determine what the device is looking at, and thus allows computer data/graphics to be displayed on-screen. This technological approach has given rise to 'mobile augmented reality', denoting use of the technology with devices such as Smartphones and tablets (Amin and Govilkar, 2015).

c) Projection-based Augmented Reality
Applies projection technology to augment and enhance 3D objects and spaces in the real world by projecting images onto any visible surfaces. This relates to the Shader Lamps research by Ramesh Raskar and colleagues and falls into the general category of spatial augmented reality as defined by Raskar and Olive Bomber. The projected images can be computer generated or photographic, and either pre rendered or generated in real time. It also requires one or more projectors arranged around an object, such as a prop or a character or distributed throughout a 3D space. If the display uses multiple projectors, their images can be independent of one another or blended together, either manually or automatically (Amin and Govilkar, 2015).

d) Superimposition-based augmented reality
Provides an 'alternate' view of the object in concern, either by replacing the entire view with an augmented view of the object or by replacing a portion of the object view with an augmented view. In this case, object recognition plays a vital role. Rationally, if the application does not know what it is looking at it (Oyekan et al, 2017).

Augmented Reality in Different Field

a) Tourism
Augmented reality has already been adopted by the tourism industry. Supported by the local office of information and tourism, Zarzuela et al (2013), recreated the city of Valladolid in Spain, allowing the user to roam the city and learn facts about it in a virtual experience. Augmented reality enables a more dynamic and innovative way to provide users with enhanced information in museums (Dieck and Jung, 2015). Conversely, resistance to adopting the technology was seen in heritage site managers fearing it would dilute the objective authenticity of the sites. Nevertheless, it is clear that a multitude of tourism-focused utilities for AR and VR have started to emerge.

b) Marketing
Augmented reality applications have appeared in marketing practice since the late 2000s (Javornik, 2016), resulting in new opportunities for summer engagement, advertisement, as well as retail and mobile marketing. Retailing in particular has embraced augmented reality, as several leading brands in the furniture, eyewear, watch, and beauty industries have created Augmented Reality apps that consumers can use on their own devices. Many of these applications utilize the magic mirror Augmented

Reality paradigm (Scholz and Smith, 2016) to enable virtual try out and evaluations of products through overlaying virtual products onto consumers' own bodies and faces.

c) Advertising
Due to the background of highly competitive consumer markets and information overload strong and distinctive brands constitute strategic resources of firms. Brands are intangible assets that enable firms to customer engagement and to accrue economic rents. High levels of brand awareness and brand knowledge can reduce risks perceived by customers in the context of purchasing and are therefore essential challenges in brand management. Brand knowledge describes the fact that consumers are able to build their own individual image of a brand based on recognition and recall. Augmented reality applications represent multilateral interactive forms of communication and therefore allow an active participation in the communication process. Interactivity can be seen as a central factor enhancing depth of information processing on the part of the consumer.

Teaching and Learning

Interactive teaching mode is a multi-directional and multi-level process of interaction between teachers and students as a whole, and between students and students. It can be completely applied by extending and enhancing the interactive mode of teaching. Various teaching fundamentals related to learning, adjust their relationship and internal interaction, promote students' active learning and development, and arrange a harmonious interaction of multi-angle, multi-level, multi-mode and multi-subject, so as to produce teaching resonance and improve teaching quality and efficiency in an all-round way (Wang, 2019).

The implementation of kindergarten curriculum is presented in five fields: health, language, society, science and art. Related to other courses; kindergarten curriculum has its own particular meaning. This kind of curriculum includes three kinds of contents, namely, knowledge of related subjects, educational theory and educational skills. Educational theory should unravel the problem of how to assimilate subject knowledge into kindergarten's educational activities. How to effectively and reasonably implement the teaching contents in five fields of kindergarten is the key to improve the educational practical ability of normal school students of this specialty (Wang, 2019).

Experiential learning is another teaching learning method that is being emphasized upon here. It further suggests that it will allow students to apply their theoretical and conceptual knowledge through activities that will develop among them skills or new ways of thinking. Experiential learning will establish and reinforce the professional skills that they will need later in their careers and members of a professional workforce (Raja, 2018).

The rapid expansion of education will cause the improving quality of education by employing interactive teaching and learning processes with the limited resources, which is also one of the cost-effective ways of improving quality of education. The emergence of augmented reality in the education system enables to reduce the previous problem and make it enhanced from traditional to the new technology using augmented reality application and to create collaborative tasks among teacher and student. Augmented Reality is the ideal solution for all educational applications and potential to explore (Bistaman et al, 2018).

Augmented Reality in Malaysia Education Systems

In this day and age, the process of teaching and learning are still relying on the traditional with verbal educational method and it is not necessarily effective (Bistaman et al, 2018). The past studies have shown that student who received verbal method is very difficult to understand and to solve the problem compare than the explanation in verbal and visual method. As a matter of fact, most of educational institution in Malaysia still applying the ineffective method to deliver their lectures which will cause the lack of interest and motivation in students.

Learning experience is a very important part in the process of teaching and learning for preschool education due to students in this age requiring more attention in order to amplify their satisfaction and motivation in the classroom. One of the methods of teaching and learning that must be changed is by including more senses such as, sight, sound, and touch. The past researcher believed that the use of augmented reality technology as a promising tool to enhance the student motivation and interest, then backing the teaching and learning process in educational context (Bistaman et al, 2018).

There are a number of advantages that come from applying augmented reality in education. For instance, students will be able to participate in authentic explorations in the real world via augmented reality. By exhibiting virtual elements alongside real objects, augmented reality enables the observations of certain events which cannot easily be observed in the real world. To such a degree, students' motivation in learning will increase tremendously along with helping them obtain better observation skills. According to Quintero et al (2019), augmented reality is very useful in education due to its "unique ability to create immersive hybrid learning environments that combine digital and physical objects, thereby facilitating the development of processing skills such as critical thinking, problem solving, and communicating through interdependent collaborative exercise."

Moreover, augmented reality also has been applied in engineering drawing classrooms in Malaysia. Engineering students require visualization skills for them to be able to master engineering courses. Furthermore, engineering drawing also plays an important role towards the efforts in improving role towards the efforts in improving their visualization skills. Thus, the use of a suitable teaching approach is required. Recent study has shown that augmented reality has proven to be one alternative to cover these issues.

Case Study 1: Froggipedia

Froggipedia is an engaging, interactive, and powerful constructive learning tool which helps users explore and discover the unique life cycle and intricate anatomical details of a frog.

The application provides an alternative to financially and ethically costly use of live frog specimens, instead replacing them with a much more accessible augmented reality-based alternative. The application is arguably a better learning tool than the 'real thing', as it allows users to observe the entire frog life-cycle -from tadpole to full grown frog -and also allows virtual dissection to understand the internal composition of the organism.

Figure 1 : Froggipedia

By using Froggipedia, it will cut down on the messiness of real frog dissection and still provides an accurate learning experience. Using an Apple pencil or their finger, users can manipulate a variety of frog models, from inside-out. The app focuses on two main components: Anatomy and Dissection.

The app's Anatomy section brings the specimen to the user. The user will simply point their iPad's camera at a nearby flat surface, like a desk or counter, and a shockingly realistic frog will appear on screen. The user will be able to examine the creature up close from all angles by walking around it or rotating it with a swipe. The app helps you identify all parts of the frog, from specific arteries in its circulatory system to the bones in its skeleton.

In the Dissection section users can utilize an Apple Pencil or their finger as a scalpel, forceps, and scissor, make incisions, peel back the frog's skin, and cut through muscle. Once the body cavity is exposed, the users will learn more about specific organs and get a close-up look at each one.

Case Study 2: Orb

Augmented reality applications allow users to create anything they desire. The Orb application is advertised as a way to build anything anywhere. According to the company's website, the user can start out by using basic 3D, colourless shapes and then building on them to create anything they want. The application also allows the user to colour, animate, and adjust the size of each object based on your desired result.

Figure 2: Orb

Case Study 3: AR Narrator

Pioneering immersive technology for kindergarten, the Narrator AR app is a writing augmented reality App that uses the AR technology to animate handwritten letters off the page. As a result of that, it encourages children at this vital stage of early childhood education to engage the essential fine motor and cognitive skills associated with handwriting.

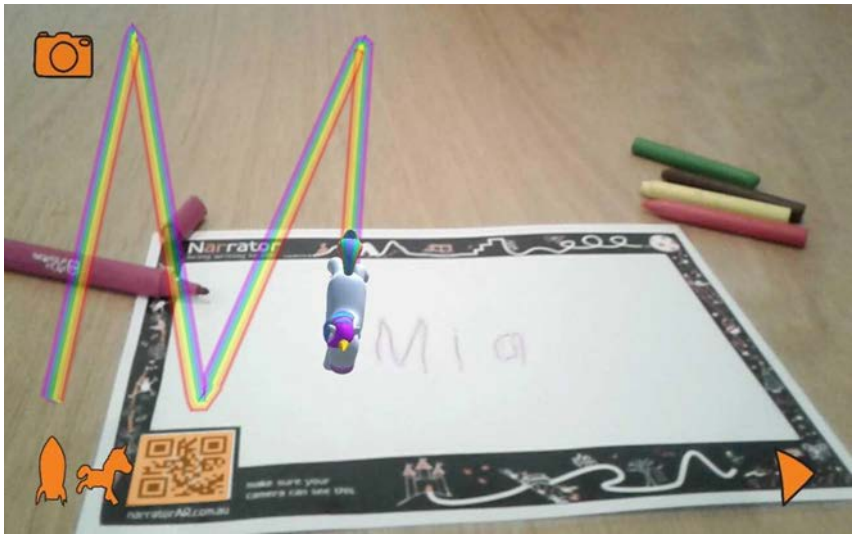

Figure 3: AR Narrator

With simple and intuitive controls children choose a rocket or unicorn character to trace the letters they have written. After that the letters appear in augmented reality as a layer of almost magic rocket dust or rainbow over the child's original work. Consequently, it will help in amplifying children's motivation to learn.

METHODOLOGY

This research methodology segment will be focused on how the application of augmented reality in pictorial dictionaries enhance the children's motivation and focus to study. Questionnaire has been prepared and has been distributed via Google Form. Collecting data will also use the same platform. The questionnaire will include multiple age groups from 15 to

41 years old. Some of the respondents just graduated high school. Some are university students. While others are from the working class and even retired. The questionnaire also asked the respondents whether they are familiar with any augmented reality applications or not. Moreover, the questionnaire also asked the respondents' opinion on the current generation children's familiarity with mobile devices and the children's reaction towards the current education system.

All the responses are then collected and compiled. This project uses ADDIE method for the methodology to make sure the project is completed without a hitch.

Data Collection Method

The information gathered for this project is acquired from various other journals, research papers, and articles available from the internet. The method that is used to gather information from potential users is questionnaire. The questionnaire was produced via Google Form and distributed the link through WhatsApp. The questionnaire is distributed among the students of Unisel with different levels of education in certain ages from 18-26 years old. There are also respondents from younger age groups such as 15-17 years old. On the other hand, there are also respondents from older age groups such as 25-41 years old and above.

Data Analysis Method

Data that have been collected and stored from the respondent has been analyzed by Google Form. Google Form also helped in providing all the required tools to create a proper questionnaire. When finished developing a questionnaire, Google Form gives the users the feature to generate a link for the purpose of distributing the form to respondents.

There are three sections available in the questionnaire. Section A, Section B and Section C. Section A is about the background of the respondent and consists of five questions. Section B is about Education method information which consists of five questions. Finally, section C asked respondents about technology which also consists of 5 questions.

After that, the data collection method is used when respondent answers the questionnaire and results respondent are from UNISEL students and other younger and older respondent, mainly the one who have any relation with children. Whether it's their own children, or their siblings. The questionnaire will be distributed through social media such as WhatsApp and Facebook. The response of the questionnaire will be automatically saved in Google Form Response immediately after the respondent submits their answer. The final step in the process is that the data will and result will be collected.

Software Development Methods : ADDIE Model

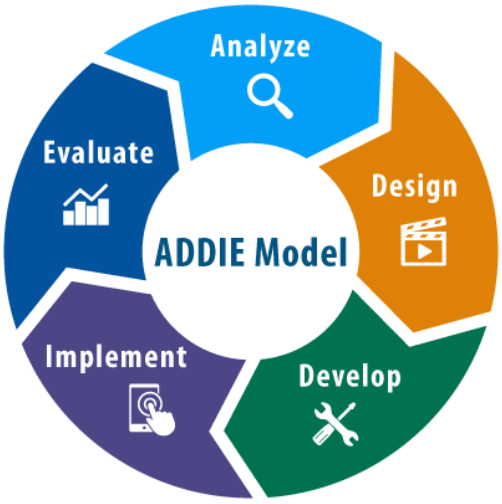

Figure 4: Addie Model

In the Analysis phase, based on the research that has been done, although technology is finally integrated into the education system. Though doing so still remains a challenge. Despite the fact that many schools today are privileged to have ready access to technology (Waddell, 2015). The potential of combining smartphones and augmented reality for education is big, though it still has to be fully discovered. By implementing augmented reality in education for children, it can make the learning process more engaging and information more comprehensible. In addition, it is also good for traditional pedagogy focused on technical knowledge and proficiencies.

In the Design phase, objects that will be used in the augmented reality application will be designed in Adobe Illustrator CS6. Not to mention, the interface also will be prepared in this phase. By doing so, the developer will know the user experience and what changes needed to be made early on. Moreover, flowchart of the augmented reality application also will be prepared in order to have a systematic and error-free application.

In the course of the development phase, multiple types of media are used such as Audio, Video, Text, and Graphic. The object for the pictorial dictionary application will be designed via 3D Maya. Text for the information about each object in the dictionary, audio for the pronunciations, and graphics for the interface all will be developed in this phase.

In the Implementation phase, after the application has finished rendering, and compositing, it will be tested by a target audience that has a mobile device along with the application installed to scan the image on the pictorial dictionary. The assigned 3D model of the image should pop out for display. Buttons that produce sound will also be tested. Any more editing for the application will be done in this phase too.

The application will be evaluated by the target audience. Their comments and opinions will be taken into consideration for further improvement.

RESULTS AND DISCUSSION

Valuable information based on the function of the application is gathered via a testing session. The analysis is based on each of the questions from the test, has been answered by the respondent.

Results

There are 10 questions given to all respondents whle they are using the application. The results or findings are as follows:

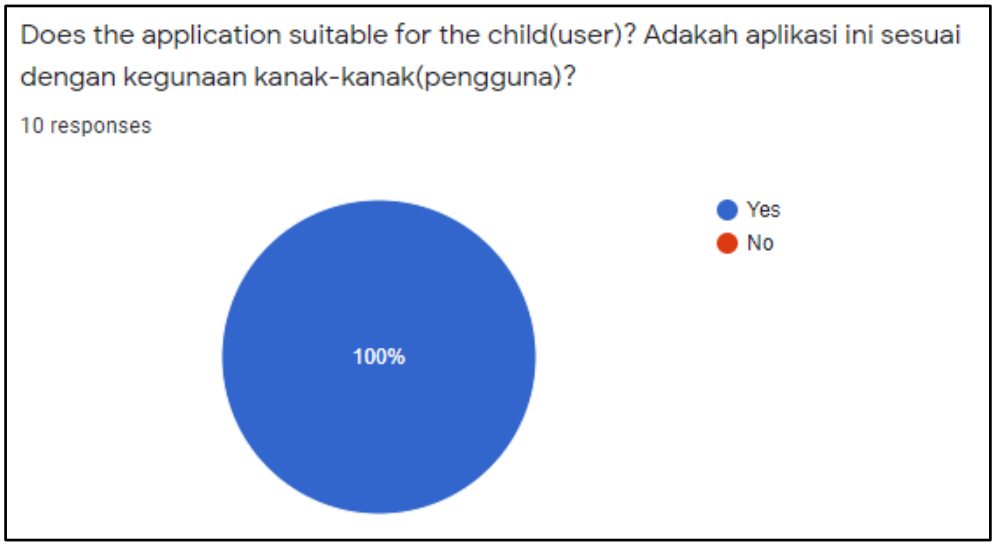

Figure 5: AR apps suitable for children

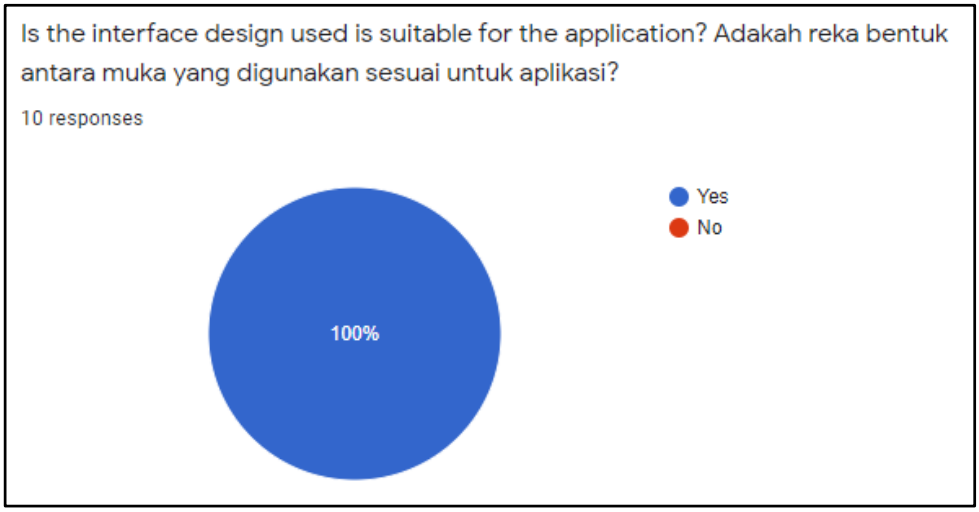

Figure 6: Interface design

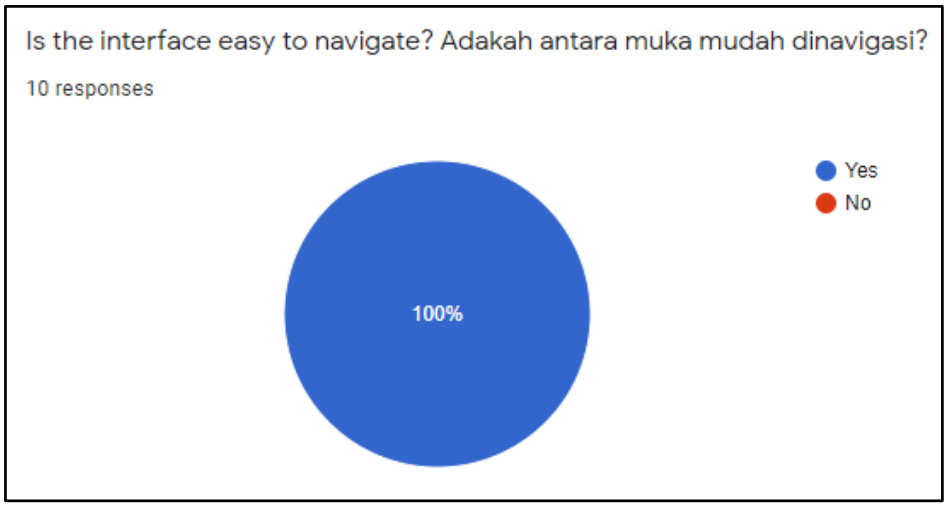

Figure 7: Navigation

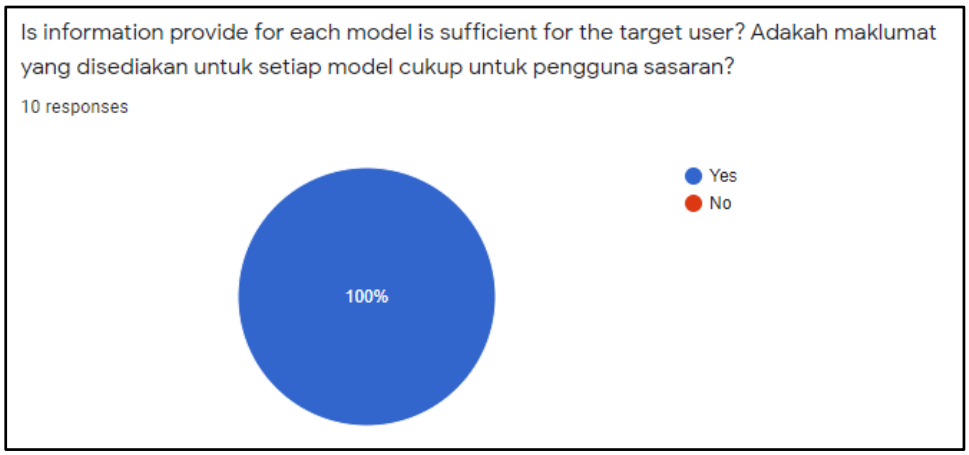

Figure 8: Apps information

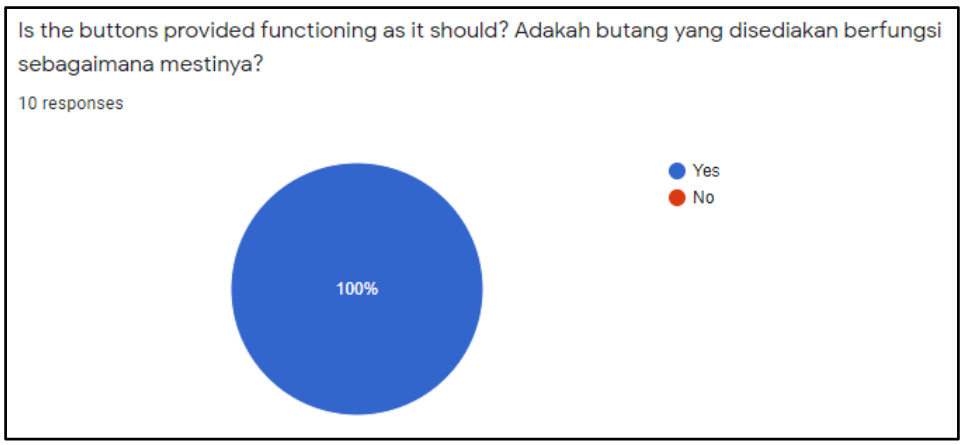

Figure 9: Apps buttons

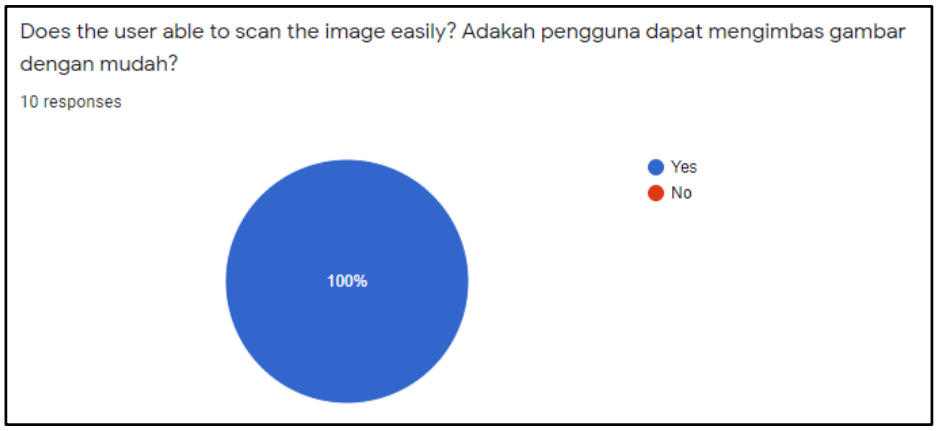

Figure 10: Scan function

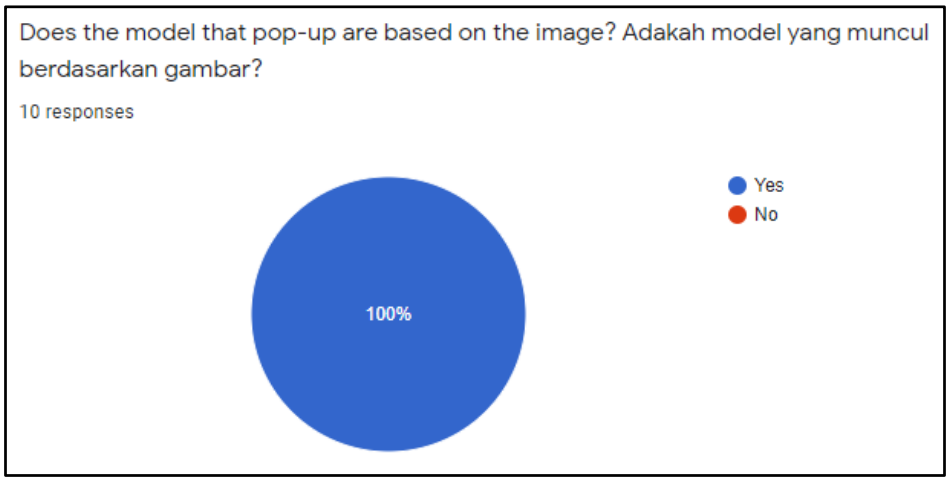

Figure 11: Pop-up function

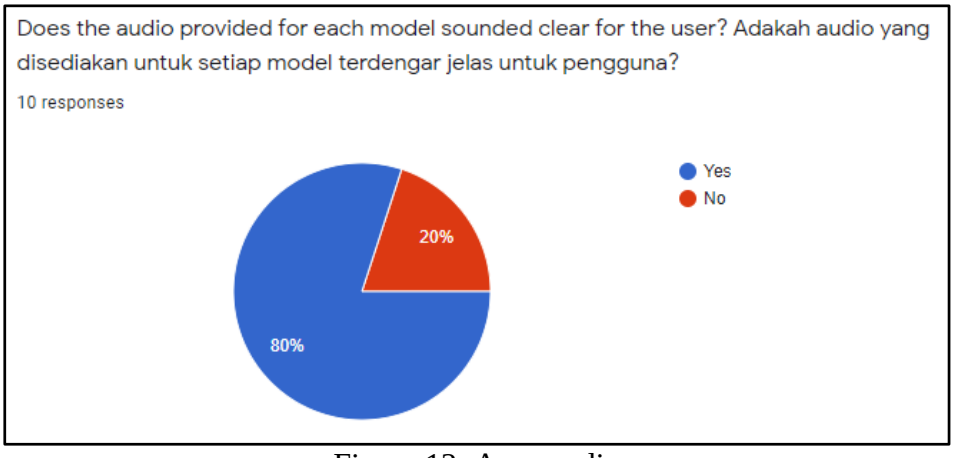

Figure 12: Apps audio

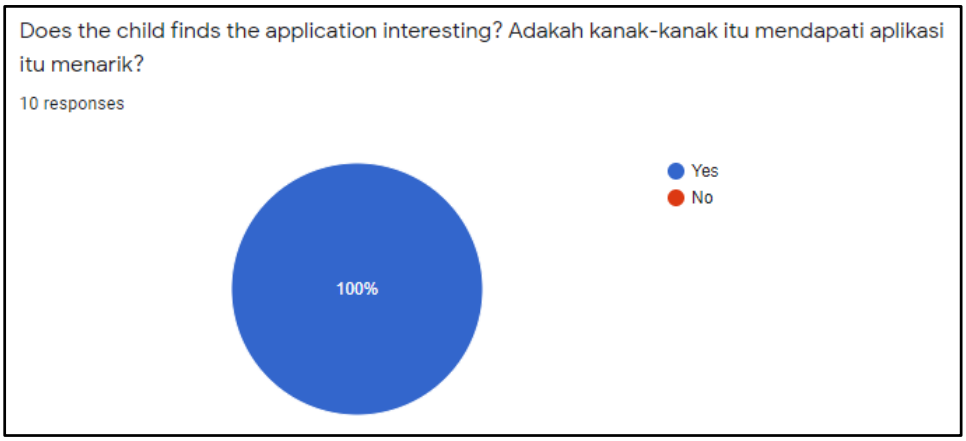

Figure 13: Attraction of apps

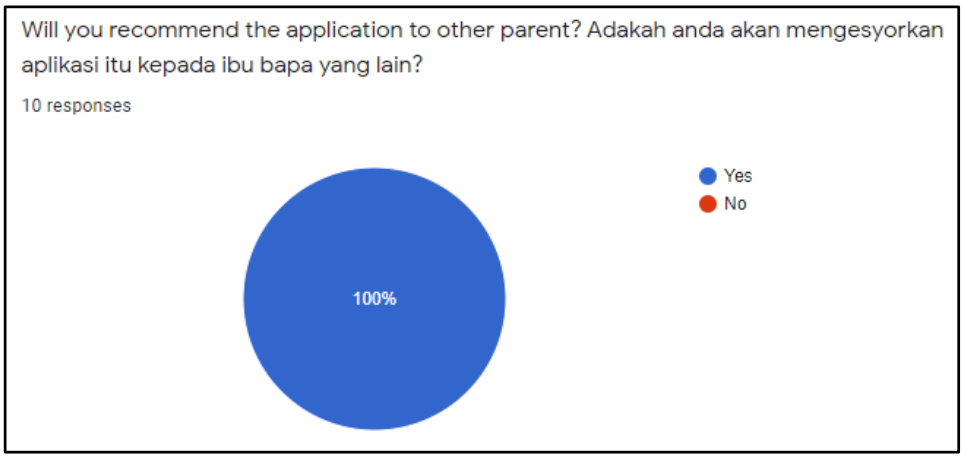

Figure 14: Apps recommendation

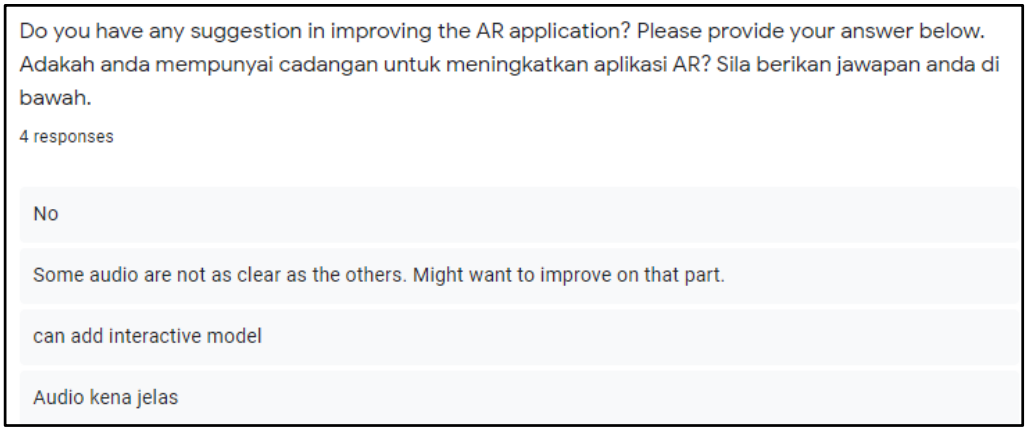

Figure 15: Suggestions

Discussion

As a final observation the entire process of implementation and testing of the project is that there is some of the audio provided for the 3D model does not sound too clear for the user that, with one respondent requested for the models to be interactive. This can be imporved in the future. Majority of the respondents accept the Augmented Reality Application for Children Pictorial Dictionary application as a part of the learning process for their children.

CONCLUSION

From what this project found from the test reults, AR technology has never been applied yet in the formal education system. The only options that are available for the public are the educational mobile applications. I hope that my application can be a stepping stone for other AR technology to rise for the public to apply in the formal education system for the future generation. Because, by applying AR technology in education, it will help in improving the learning environment for the student by making it interactive, interesting, and at the same time can easily grab their attention in their studies. Besides in the education field, other fields such as gaming, marketing, healthcare, and etc, can also be influenced with AR technology.

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