AUGMENTED REALITY (AR) APPLICATION FOR CHILDREN: UNDERSTANDING THE WORLD AROUND US

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DECLARATION

I hereby declare that this project report entitled

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is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date : 9/8/16

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I hereby declare that I have read this project report and found this project report is sufficient in term of the scope and quality for the award of Bachelor of Computer Science (Interactive Media) With Honours

SUPERVISOR: _____ Date: 9/8/16

(EN MUHAMMAD HAZIQ LIM B. ABDULLAH)

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DEDICATION

To my beloved parents and family, thank you for your unconditional support with my studies. I am honoured to have you as my parents and family. Thank you for giving me a chance to prove and improved myself through all my walks of life.

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ABSTRACT

This project discussed about Augmented Reality (AR) application, with marker as a supporting tool for children during classroom activities and promotes building and enhancing cognitive and soft skills among preschoolers. The prototype was developed after an observation with the subject matter (Science) and questionnaires were conducted with pre-school teachers, and preschoolers of age five to six years old. Based on the result findings, children difficulties to improve their cognitive and soft skills are mostly due to lack of confidence and focus in the classroom. Teachers' summary during the surveys after testing the prototype is that preschoolers' less focus in subject content cause low performance by the children during teaching and learning in the classroom. There are five findings made based on observations after the product testing conducted which are: (1) AR helps to increase each child's participation during the learning process. (2) AR helps to facilitate peer-to-peer interaction. (3) AR helps to promote engagement towards learning. (4) AR helps to build self-confident in children, and AR helps to support independent learning. Apart from AR as a supporting to assist teachers during classroom activities, it also helps to promote, facilitate and build cognitive and soft skills among children.

ABSTRAK

Projek ini membincangkan tentang aplikasi Augmented Reality (AR), dengan meggunakan 'marker' sebagai alat sokongan bagi kanak-kanak semasa aktiviti di dalam kelas dan sebagai galakan untuk mereka membina dan meningkatkan kemahiran kognitif dalam kalangan kanak-kanak pra sekolah. Prototaip ini dibangunkan selepas melakukan pemerhatian terhadap kandungan subjek Sains dan soal selidik telah dijalankan dengan guru-guru dan kanak-kanak prasekolah berusia lima hingga enam tahun. Berdasarkan hasil dapatan kajian, kanak-kanak sukar untuk meningkatkan kemahiran kognitif mereka adalah sebahagian besarnya disebabkan oleh kekurangan keyakinan dan fokus dalam kelas. Guru-guru tersebut membuat ringkasan bahawa kanak-kanak prasekolah kurang fokus pada kandungan subjek menyebabkan prestasi rendah oleh kanak-kanak semasa pengajaran dan pembelajaran di bilik darjah, selepas menguji prototaip ini. Terdapat lima kategori yang dapat disimpulkan berdasarkan pemerhatian selepas ujian terhadap prototaip dijalankan iaitu: (1) AR membantu untuk meningkatan penyertaan kanak-kanak semasa proses pembelajaran. (2) AR membantu untuk memudahkan interaksi dengan rakan sebaya. (3) AR membantu menggalakkan penglibatan yang mendalam terhadap pembelajaran. (4) AR membantu untuk membina keyakinan diri kanak-kanak, dan (5) AR membantu seagai alat sokongan untuk pembelajaran kendiri. Selain AR sebagai alat sokongan membantu guru semasa aktiviti di dalam kelas, ia juga membantu untuk menggalakkan, memudahkan dan membina kemahiran kognitif dalam kalangan kanak-kanak.

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CHAPTER I

INTRODUCTION

1.1 Introduction

The amount of information and knowledge available to humakind today is increasing steadily. Ofcourse there is no indvidual had as much information at his/her fingertips about the whole world without experiencing or learning about them before. The understanding on how the problems around them also individually different and needs a source to focus on the most important thing they need to know and understand. The idea of AR is to mingle what is not really there with what is there as seamlessly as possible, and to present users with an enhanced, or augmented, displays of the world around them in a more immersive and attractive way.

1.2 Problem Statement

According to Fox E from 'Art in Early Childhood: Curriculum Connections' website, he claimed that Froebel F.(1826), the father of kindergarden believed that arts are one of an important activities kids should be enjoying and doing with friends. According to him, the reason is not to grab attention from the teacher to show how good and talented the kids are in arts but arts can actually develop many important

needs for a child's growth and ability development such as emotional satisfaction and their opportunity to make independent choices and decisions. Self-exploration from this activity will also help children to build knowledge of the objects in the world around them, in other words, cognitive development. Children. This activity also very immersive as children need to focus and think of what they should be doing and make it successful. Even so, the interaction between coloring books, drawing blocks and tools for artwork are yet limited in usage. Children have limited time to do these arts as they can only do the arts freely under the attention of parents, guardians or teachers (supervisions) to avoid from any danger when using tools freely such as poking around with sharp pencils or throwing tools around. We know children are not to be blamed as whole as it is their nature to play around and have fun.

Some parents stated that "Some art is just fun with no purpose or reason, just creating, getting messy, and the joyful of being a KID!" Ashley (parent). From the transcript of *The Importance of Art in A Child'Development* written by MaryAnn F. Kohl, she quoted several dialogues from mothers, "*My kids express things through their art that they don't even have words for yet*", "*Art helps my kids feel willing to try new ideas, to experiment, to solve problems*" Lindsay.

Based on Methods of Psychological Research Online, 'Misinterpretations of Significance: A Problem Students with Their Teachers?' by Heiko Haller and Stefan Krauss claimed that indeed textbooks have already been detected as a possible source of misconceptions. An especially a striking example is the book called 'Introduction to statics and psychology and education' by Nunally J.C. (1970). Within three pages, Nunally J.C. provided eight interpretations of significant test result that are all wrong. The problems regarding to children learning when the teacher teaches the children and some of the children raised their hands asking questions sometimes far from the actual thing that were taught is because of different understanding from passive learning. Even with the reference of textbooks to see and understand what the teacher is talking about, without detailed view, many other error interpretations can be made by children. This sometimes cause a little trouble for the teachers to explain it to the students repeatedly in many forms and sometimes needed to reenact the exact information in a form

children can see graphically and imagine. AR can provide the image needed by these teachers clearly.

Early Childhood Research and Practice stated that "knowledge cannot be *given* directly from the teacher to the learner, but must be *constructed by the learner and reconstructed* as new information becomes available" (Ryan & Cooper, 2000, p346). This shows that experiencing the knowledge itself is important for childhood learning development. Interactions between a child and the objects are the real learning development itself unconditionally. Even with the information given with direct spoon feeding to the children in order for them to learn, it is never the same with allowing them experiencing something more realistic.

1.3 Objective

The project objectives are:

i. To study and understand how children experiences through augmented reality application supports them in self-studying in the classroom.
ii. To design and develop AR application that can help assisting kindergarten teachers in classroom.
iii. To evaluate the usability of augmented reality among children to support their learning in kindergarten.

1.4 Scope

The target project involves children from age 6 years old, kindergarten school and teachers. It is to see how Augmented Reality can be applied in teachings in kindergarten and children self-studying with and without parental guidance.

Platform will be use is Android-based OS smartphone.

Figure 1.1 shows statistic prove for the percentage of users for mobile operating system from Suruhanjaya Komunikasi dan Multimedia Malaysia (SKMM) up until July 2016. The statistic proven that Android is mostly being used by Malaysians leading by 38% from iOS.

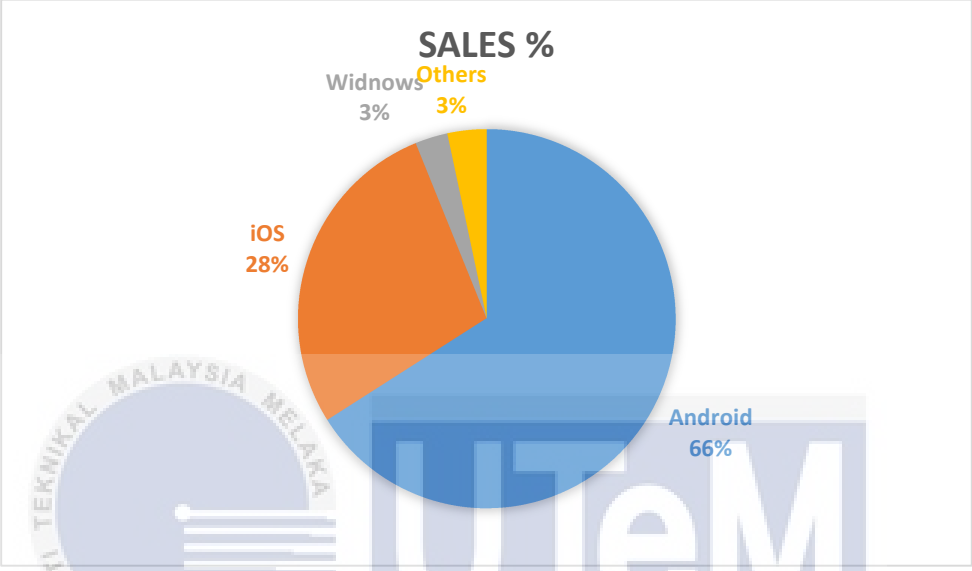

Figure 1.1: Statistic prove for mobile OS users in Malaysia by SKMM, July 2016

1.5 Project Significance

The significance of the project are:

i. People targeted to benefit from this project are teachers, parents/guardians, children age 5-6 years old.

ii. This project aims to help assist teachers in teaching while students understand well and immerse into learning process.

iii. This project is to help reduce parents/guardians worries over their children in learning alone without feeling bored and do other dangerous things while they are not under supervised.

1.6 Conclusion

The conclusion for this project is to ensure positive feedbacks that augmented reality is helpful for teachers in teaching, and children to learn and understand either with or whitout supervised and ease of worries from parents over their children way of studying and learning things at the very young age. The age of where ‘what they see is what they get’ innocently and non-manipulative. Ensuring that children grow up understanding things well and easier for them to survive later in elementary school and life after that is crucial.

CHAPTER II

LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

This chapter will discuss about literature review that related to this project and also type of methodology used in developing the project. The purpose of literature review is to understand the background of the selected topics and compare each existing findings then identify the gap for this project to fill. Methodology is a codified set of practices that may be go through repeatedly to produce the product. Methodology is important as it gives a clear concept on project activities in each process.

2.2 Domain

There are two domains for this project which are Augmented Reality (AR) and Children learning in the classroom. The combination of these domains can be categorised into three which are: AR is a promising tool for teaching and learning in a classroom, AR promotes positive learning environment for children in a classroom, and AR foster positive skills for children in a classroom.

i. Augmented Reality (AR) is a promising tool for teaching and learning in a classroom.

Augmented reality (AR) is potential as a **supporting tool** for teaching and learning in the classroom. Karewalla et. al. (2006) stated that AR is useful to promote better understanding through interactive content such as rotating and manipulating images. Billinghurst et al. (2001) and Uvelli et. al. (2005) mentioned that AR books also able to provide digital pathway to learners and the characteristics of AR techniques have overcome the drawback of traditional teaching and learning methods that rely on printed resources and lecturing activities as well as shortcomings of other technologies (including computer-based education and virtual learning environment). In a similar vain, Squire et. al. (2007) stated AR might be a productive vehicle for supporting students in learning through interactive AR games where students able to interact with the contents and decide suitable path to complete the game quest (enhance argumentation skills). Johnson et al. (2010) stated that AR has strong potential to provide powerful contextual, on-site learning experiences, exploration and discovery of the connected nature of information in the real world. Tomi et. al. (2013) stated that AR has potential to enhance physical storybook by augmenting the book page with graphic animations and audio. Gunther et. al. (2013) mentioned that AR based learning environments induced significant cognitive improvement with respect to an increased knowledge and performance. Specht et. al. (2011) claimed that AR allows us to devise and design innovative learning scenarios in real world settings. Therefore, AR is a potential supporting tool in teaching and learning for children in the classroom by implementing enhancement of animation and audio, or interactive content such as simple AR game.

AR tools are **simple and user friendly** for children at age of preschoolers in the classroom and self-learning. Uvelli et. al. (2005) stated in their AR Tangicam research that the interaction is simple enough even for very

young children. They admitted that children were amazed to find that AR Tangicam can be grasped effectively used by as many as eight 5-8 years old at the same time. Tomi and Rambli (2013) stated that Mobile AR application with playbook is easy to use especially for young children. They added that after the research, most parents asked whether the book, together with mobile AR application is already available at the moment in the market. Chowdhury et. al. (2013) mentioned that, AR markers play important role to ease users in using AR technology application. It is important to achieve accuracy and precision during the tracking process. They added that AR applications developed must be simple to install and use for both teachers and the learners. Krevelen and Poelman (2010) stated that Feiner believes "augmented reality will have a more profound effect on the way in which we develop and interact with future computers." They also mentioned that AR might soon pave the way for ubiquitous (anytime-anywhere) computing of a more natural kind or even human-machine symbiosis as Licklider as already envisioned in the 1950s. AR is a learning medium that can easily be used by preschoolers to experience interactive learning through simple and accurate AR markers and easily installed apps for the teachers and learners.

ii. Augmented Reality (AR) promotes positive learning environments for children in a classroom.

AR provides **immersive** learning process for children in preschool. Kaufmann (2002) stated that one of the psychological factor of importance in educational purposes is that some users feel unsafe if their view is 'locked' in an immersive virtual world whereas AR allows them to 'keep control', to see the real world around them while learning process is still immersive. Kaufmann (2009) also added that using AR application, teachers and students can intuitively explore properties of contents in great details. This leads to students' curiosity towards subject's contents and provides immersive involvement. Lee K. (2012) mentioned that AR can make educational environments more productive, pleasurable, interactive and immersive. Students in schools can

improve their knowledge and skills, especially on complex theories or mechanism of systems or machinery. AR can make complicated mechanisms and difficult theories accepted and understood by students with contextually enriched interaction. Billinghurst (2001) determined that people, especially for young children, can read books in more interactive and realistic ways by superimposing 3D rendered models onto books with AR technology. The method caused the children to immerse into the 3D presented images from the books and allowed them to immerse into reading until the end of the story. Liarokapis et. al. (2004) mentioned that 3D model allow students to understand aspects of the teaching material that is not evident in the pictures, because they are hidden and metadata can provide descriptive information about the teaching material that cannot be provided by the picture and 3D model. A combination of Web 3D and AR technologies help students to explore the multi-dimensional augmentation of teaching material in various levels of detail. Students can navigate through the augmented information and therefore concentrate and study in detail any part of the teaching material in different presentation formats, thus adding understanding. Therefor AR helps children to immerse in what they are learning through clearer images (3D image) thus improve their understanding.

AR tool promotes **collaborative** learning process that enhances social skills among children and teacher in the classroom. Squire et. al. (2007) stated that AR encouraged collaboration and served as scaffolding for reading and encourage students to share information, synthesize what they read, communicate orally with their group, ask questions and debate meanings. Kaufmann (2009) stated that users feel unsafe if their view is 'locked' in an immersive virtual world whereas AR allows them to keep control between virtual and real world around them and allows collaborative learning where AR gives users freedom of sight to move around, communicate with teachers and classmates. He added that one of the most important purposes of an educational environment is to promote social interaction among users located in the same physical space. Gunther et. al. (2013) claimed that with AR approaches, learners can collaboratively use the presented material by listening to the content,

looking at overlaid images and additional material right away, which also encourages social interaction. Research on brain development by the National Research Council Instituted of Medicine suggested that children are born needing extra attentions towards their feelings and early nurturing relationships which are essentials and set the groundwork for future well-being and learning. Dini L. et. al. (2015) claimed that American Academy of Pediatrics (AAP) mentioned about young children have short attention spans (1-10 minutes) and claimed that discretion must be used and the media used should be weaved in with conversations and social interactions to break up the time into chunks that can be assimilated by the child. Technologies should be used to support interventions when needed. When a child experiences difficulties in development, no matter the severity, it is crucial for the adults on that child's life to collaborate, communicate, and plan together the use of educational technologies or assertive technologies for access and communication. Therefore, AR helps passive learning into collaborative learning where children can interact with teachers and classmates while enhancing social skill, thus can become an essential learning tool to developed children's well-being and learning in the future.

AR enhances preschoolers' self-learning **engagement** in the classroom. Karewalla et. al. (2006) conclude that AR has potential to engage, stimulate and motivate students to explore class materials from different angles. Squire et. al. (2007) claimed that educators might benefit from incorporating reflective activities with AR that call students' attention directly to the mechanisms, encouraging them to adopt these practices in their own reading. Santoso et. al. (2012) claimed that users become more engaged and interested learning with AR tools than just using conventional method. The other advantages that rose up from his experiment is the using of colorful marker. Dunleavy et. al. (2009) discussed in their AR research project that students highly engage across the sites over the course of the year. Dunleavy et. al. (2006) interviewed some teachers stated most of the time in their classes, they (student) can do the work, but they tend to get off track so easily. But throughout the research was made, they were focused, really engaged and they wanted to figure out what the

problem was. They made the same research in 2007 and the teachers responded that the kid with ADD will not sit in class at all before but after using the AR materials, they were 100% engaged. Gunther et. al. (2013) mentioned that AR systems provides sufficient stimulating which result in high motivation when using the augmented textbook with animated 3D images compared to traditional textbook. Krevelen et. al. (2010) mentioned that MIT Education Arcade introduced game-based learning in 'Mystery at the Museum' and 'Environmental detectives' and each educative AR game has an "engaging back-story, differentiated character roles, reactive third parties, synthetic activities, and embedded recall/replay to promote both engagement and learning". AR application acts as an engaging tool which could help not only students in learning but also teachers to attract students into focusing the subject material they were teaching through colorful markers and alive 3D images.

AR promotes **attractive and fun** self-learning experience for children in classroom. According to Yuen et. al. (2011), AR offers opportunities for learners to undergo unique, customised, personalised learning experiences. They added that rather than learning through interactions with a teacher and classmates, many individuals may find it more efficient, less stressful, or otherwise preferable to utilize AR learning modules independently, at whatever pace and order they wish. Uvelli et. al. (2005) claimed that the augmented coloring book had made the children stimulated to observe the results of each page of the book and understand the importance of checking the content of each page giving relevance to the experimental aspects of the book. This attractive feature is important as according to American Academy of Pediatrics (AAP) young children have short attention spans which around 1-10 minutes. Also stated that the AR pop-up book teaches the children colors in a more attractive way where the color changes occurs from a chameleon model depending on color combination shown in book. They conclude that the experience with the Book of Colors proves that AR can be effectively used for providing innovative and attractive learning experience for children. Poonsri Vate-U-Lan's studies (2011) shows AR is more attractive to use in learning compared non-technological 3D pop-up book. As in AR, objects also appear in 3D yet able to