AUGMENTED REALITY APPLICATION TO IMPROVE REMEDIAL STUDENT'S LEARNING PERFORMANCE

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For my beloved mother and father whom the author greatly admires and cherishes. Thank you for always filling in the author with love, and dedication. Thank you for teaching the author how to be a better person. Thank you for not giving up on the author, despite the fact that the author was not strong enough to handle the situation alone. Thank you for all the sacrifices you've made throughout the years. Thank you for giving the author the encouragement. Above all, thank you for giving birth to the author, caring for him, and raising him to be your son.

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ABSTRACT

Since pre-school and primary school, Mainstream Education (ME) has been the standard education for all students. However, in order to help learning difficulties' students in reading, writing, and arithmetic (3M), the Ministry of Education (MOE) put in extra effort in Teaching and Learning (T&L). The MOE implemented the Remedial Education Program (REP) to address this learning issue. In the classroom, REP remedial teachers typically used traditional methods such as learning books or card puzzle boards, which are less interactive and have a low impact on remedial students (RSs). In order to introduce the different way of fun T&L in the REP, researcher have proposed a cloud-based Augmented Reality (AR) learning application which is called Remedial Module Augmented Reality (ReModAR). The main software used to develop cloud-based AR application are Unity 3D, Vuforia, and MySQL. ReModAR is a learning application that is specifically designed to help RSs master some Malay Language skills through quizzes. A personal computer serves as a workstation for designing, developing, and simulating the ReModAR application in terms of hardware. To test the application's compatibility with an android system device, android smartphones were used. A comparison of the conventional method of card puzzle boards versus ReModAR has been investigated and analysed to determine the RSs learning performance. According to the data analysis for each skill, it is clear that using the ReModAR improves the learning of the Consonant-Vowel-Consonant (*KVK*), Digraph, Consonant-Vowel-Consonant-Consonant (*KVKK*), and Vowel-Consonant-Vowel (*VKV*) skills for the RSs by an average of 31%. Researcher believe that ReModAR has the potential to become a new learning material for RSs due to its interactive and entertaining learning style. Furthermore, it makes the teachers' routine life of marking quizzes easier because all quizzes results are automatically saved in the cloud. This feature enables remedial teachers to easily track their students' progress and performance.

ABSTRAK

Pendidikan Arus Perdana (PAP) diwujudkan untuk menyediakan pendidikan yang piawai untuk semua murid, bermula dengan prasekolah dan sekolah rendah. Walau bagaimanapun, untuk membantu pelajar bermasalah pembelajaran dalam Membaca, Menulis, dan Mengira (3M), Kementerian Pendidikan Malaysia (KPM) sedang berusaha mewujudkan kurikulum baharu bagi membantu menambah baik pengajaran dan pembelajaran (PdP). Justeru, KPM telah melaksanakan Program Pendidikan Pemulihan (PPP) bagi menangani masalah pembelajaran ini. Di dalam bilik darjah, guru pemulihan PPP biasanya menggunakan kaedah tradisional seperti buku teks atau papan kad teka-teki, yang kurang interaktif dan kurang memberi kesan kepada pelajar pemulihan (PP). Untuk memperkenalkan cara PdP yang menarik dalam PPP, penyelidik mencadangkan aplikasi pembelajaran berasaskan realiti terimbuh (AR) yang dilengkapi dengan pengstoran awan bernama Remedial Module Augmented Reality (ReModAR). Perisian utama yang digunakan untuk membangunkan aplikasi AR dengan storan awan ialah Unity 3D, Vuforia, dan MySQL. ReModAR ialah aplikasi pembelajaran yang direka untuk membantu PP menguasai beberapa kemahiran bahasa Melayu melalui kuiz. Komputer peribadi digunakan sebagai stesen kerja untuk mereka bentuk, membangun dan mensimulasikan aplikasi ReModAR dalam perkakasan. Untuk menguji keserasian aplikasi dengan peranti sistem android, kami menggunakan telefon pintar android. Perbandingan kaedah tradisional kad teka-teki dengan ReModAR telah disiasat dan dianalisis untuk menentukan prestasi pembelajaran PP. Berdasarkan analisis data bagi setiap kemahiran, jelas menunjukkan bahawa penggunaan ReModAR meningkatkan Konsonan-Vokal-Konsonan (KVK), Digraf, Konsonan-Vokal-Konsonan-Konsonan (KVKK) dan Vokal-Konsonan-Vokal (VKV). Kemahiran untuk PP meningkat secara purata sebanyak 31%. Penyelidik percaya bahawa ReModAR berpotensi untuk menjadi bahan pembelajaran baharu untuk PP kerana gaya pembelajarannya yang interaktif dan menghiburkan. Selain itu, ia menjadikan tugas harian guru menandakan kuiz lebih mudah kerana semua keputusan kuiz disimpan secara automatik dalam pengkomputeran awan. Ciri ini membolehkan guru pemulihan menjejak kemajuan dan prestasi pelajar dengan mudah.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

UTHM   -   Universiti Tun Hussein Onn Malaysia

3M   -   reading, writing, and arithmetic

3D   -   three-dimensional

ME   -   Mainstream Education

REP   -   Remedial Education Program

SEP   -   Special Education Program

SED   -   Special Education Division

T&L   -   Teaching & Learning

RS   -   Remedial Student

AR   -   Augmented Reality

VR   -   Virtual Reality

ADDIE   -   Analysis, Design, Development, Implementation, and Evaluation

ReModAR   -   Remedial Module Augmented Reality

OS   -   Operating Systems

IaaS   -   Infrastructure as a Service

PaaS   -   Platform as a Service

SaaS   -   Software as a Service

SQL   -   Structured Query Language

DBMS   -   Database Management System

P1NCH   -   *Program 100 Persen Celik Huruf*

KVK   -   Consonant-Vowel-Consonant

KVKK   -   Consonant-Vowel-Consonant-Consonant

VKV   -   Vowel-Consonant-Vowel

VLE   -   Virtual Learning Environment

MOE   -   Ministry of Education Malaysia

MOH   -   Ministry of Health

IR4.0   -   Industry Revolution 4.0

UNICEF	-	United Nations Children's Fund
IQ	-	intelligence quotient
SDK	-	Software Development Kit
VAKT	-	Visual, Audio, Kinesthetics, Tactile
BM	-	*Bahasa Melayu*
MT	-	Mathematics
LINUS	-	Literacy and Numeracy Program
APD	-	Auditory Processing Disorder
AIM	-	*Agensi Inovasi Malaysia*
PPD	-	*Pusat Pendidikan Daerah*
PAP	-	*Pendidikan Aliran Perdana*
KPM	-	*Kementerian Pendidikan Malaysia*
PdP	-	*Pengajaran & Pembelajaran*
σ	-	population standard deviation
N	-	size of population
x_i	-	value of each population
μ	-	population mean
$\%$	-	Percentage
C	-	conventional total time score of each skill
R	-	ReModAR total time score of each skill
sum	-	sum of each skill % difference
$count$	-	number value of each skill % difference
$Tsum$	-	sum of all skills % difference
$Tcount$	-	number value of all skills % difference

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research Background

Malaysia's educational system is evolving to become more advanced and world-class in order to increase students' ability to find and learn new things [1]. Every youngster in Malaysia is assured to have improved abilities and knowledge in numerous domains as a result of human capital development [2]. Unfortunately, due to some students' learning problems, not every student is able to reach their full potential. Learning in a single stream is not appropriate for a student with a learning problem, whether it is in reading, writing, and arithmetic or in malay is *menulis, membaca and mengira* (3M) [3] or intelligence. Starting in primary schools, Malaysia's education system has been separated into three categories, which are Mainstream Education (ME), Remedial Education Program (REP), and Special Education Program (SEP), as shown in Figure 1.1.

All these categories encompassed the educational spectrum, from ordinary students to those with learning disabilities and difficulties. Typically, primary and secondary students who do not have any learning difficulties or learning disabilities follow the ME by default, with all these kids being assigned to a certain class according to their academic performance. REP is a sort of education programme designed to help students with learning difficulties in 3M. Finally, the SEP is an educational programme for students with disabilities who have been certified by a medical practitioner, optician, audiologist, or psychologist as having vision, hearing, speech, physical, or any combination of disabilities.
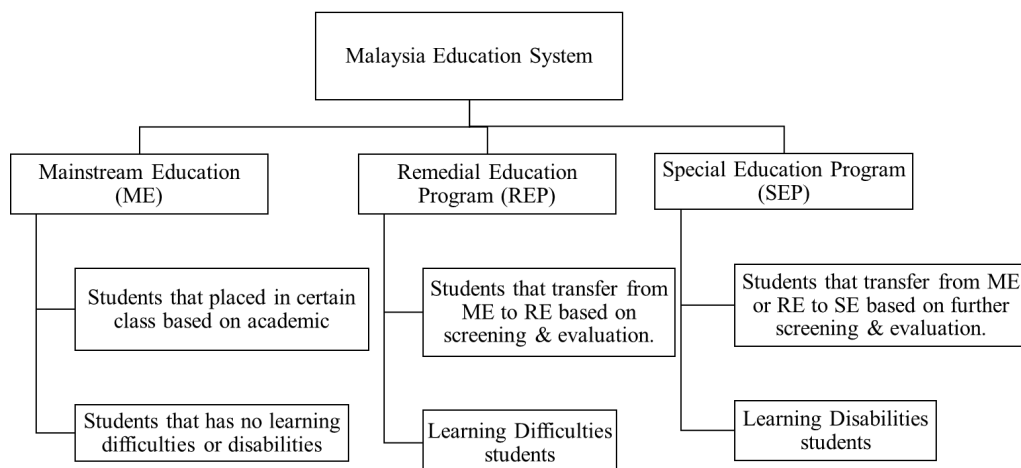
Figure 1.1: Education stream of Malaysia Education System.

For some people, the words learning difficulties and learning disabilities can be confusing. Most people assumed that when a student had a learning disability, he or she was labelled as a special student. To be clear, learning difficulties and learning disabilities are not the same thing. According to a prior study, the trends of primary students with learning difficulties in 3M have shown an increasing number of percentages [4] from 2004 to 2008. The term "Learning Difficulties" refers to students who struggle with developing academic abilities such as speaking, reading, writing, or mathematics [5] .

Difference with "Learning Disabilities", they are genetic or neurobiological problems that impede the brain's ability to process information. It is a condition that has the potential to affect an individual's health, IQ, life skills, and physical state [6]. Students with learning problems in mainstream education are reported by their teachers, who are then checked and evaluated [7] before being referred to REP. Meanwhile, they must go through the interview process for the SEP. The panels include a qualified medical doctor from the Ministry of Health (MOH), an officer from the Department of Social Welfare, and a special education official from the District Education Office. Before they may be classified as students with learning difficulties, these panels must assess the students during the interview.

REP and SEP both have their own specialised, structured programmes aimed at assisting students who require extra support academically. REP is for learning difficulties or known as a remedial students (RSs) that are struggling in 3M while SEP

is for learning disabilities or a special students who lack intellectual ability and that affects all areas of life [8]. These statements were also being proof by remedial teachers in this research, the author stated that RSs' problems in 3M can be cured while special students were placed after being examined and checked by the panels when there is no improvement in their learning in REP. Classes in REP, trained remedial teachers mostly used the Teaching and Learning (T&L) method via colouring books, flash cards or word puzzles.

However, additional analysis reveals that this conventional method takes a lengthy time to train the RSs [2], posing the primary problem in this situation. This is because RSs must master 3M within a certain amount of time before being transferred back into ME based on the remedial teachers comment in this research. The conventional method of T&L is to blame for the fact that most RSs struggle to finish their learning on time. This strategy has no discernible effect on the RS's attention or motivation to engage in remedial learning. Implementing new interactive learning methods, such as Augmented Reality (AR), is an alternative strategy to overcoming these issues.

As demonstrated in Figure 1.2, AR can project a 3D image in real time and allow the physical world to interact with virtual content [9]. The projected 3D image is extremely useful in the educational sector, particularly for students who are unable to visualise certain objects without being able to see or understand them, such as a vehicle, animal, or food.

Figure 1.2: Example of education using AR.

To see the outcomes of including AR as one of the learning materials in REP. A series of data collecting is required to show that AR can boost RSs' learning process. It is impractical and time intensive to collect all the data in a form of sheet and manually enter it into a system. The series of data can be kept automatically in the cloud, minimising the time it takes to manually enter the data, and remedial teachers

can monitor data from anywhere over a network [10], [11]. The use of AR and the cloud together improve remedial students' learning while also benefiting remedial teachers.

This study transformed the T&L method in remedial education by utilising some of the technologies found in Industry Revolution (IR) 4.0. Using Unity 3D software and the Vuforia Software Development Kit (SDK) in order to develop an AR learning application. Because of its well-established function of advanced analysis through modelling, optimization, and predictive analysis, the MySQL cloud database platform is utilised to make the research easier to achieve results. The researcher believe that this study has introduced a new function to the AR education platform which is cloud storage. This is because the cloud storage for this application is in the process of the patent filing. The researcher anticipates that with this update, the remedial teacher will be able to efficiently monitor the quiz outcomes and store the data.

1.2   Problem Statements

T&L methods that are uses by school are mostly the conventional types [12]. It's known as the 3M curriculum, and it includes reading, writing, and counting. Students with learning difficulties and learning disabilities can benefit from the 3M programmes. However, some study like Riyanto [13] and Ishak [14], focus on learning disabilities and learning difficulties students that has problem in mathematical and reading by using a conventional learning approach like Microsoft PowerPoint and VAKT (Visual, Audio, Kinesthetics, Tactile) methods and these two methods can be modernize together by using AR to create a new learning approach. Kellems [15], who used an AR learning strategy that covered 3M for children with learning disabilities and learning difficulties, but the usage of AR technology can still be broadened by merging it with other technology, such as cloud-based systems. Chiazzese [16] used and AHA web-based AR systems that have support cloud-based systems but required a user to customize manually the learning type they want.

Most of the remedial learning material uses the conventional book, flashcard, and flash-based e-learning as seen on Figure 1.3 and 1.4, which lacks interaction, and the impact of learning on RSs is low. Thus, the development of this application can

increase the remedial students learning abilities. It has been proved by the data results analysis in Chapter 4.

Figure 1.3: Conventional card learning material.

Figure 1.4: Conventional flash-based e-learning [17].

Previous study [18], certain concerns were raised during an interview with the remedial teachers, and the teachers have decided to focus on the *KVK* (Consonant-Vowel-Consonant, skill eight). When they are in remedial class, most RSs are struggling to catch up with the *kemahiran* or skills of Bahasa Melayu. The T&L Guidebook Bahasa Melayu was used. This guidebook has thirty-two skills, all of which must be mastered by RSs [19]. Previous study, only half of the KVK material is covered.

Additionally, this research cover more skills that are required by remedial teachers which are the Digraph (skill thirty), *KVKK* (Consonant-Vowel-Consonant-Consonant, skill sixteen) and *VKV* (Vowel-Consonant-Vowel, skill six) [9]. The *KVK, KVKK, VKV* and Digraph are part of thirty-two skills inside the guidebook. These four skills are the one that RSs are struggling with to spell, pronounce and remember. If they do not master these four skills, they cannot move with others skills that comes after that. Figure 1.5 shows an example of the thirty-two skills based from the

guidebook in tree form. Apart from the red colour is another remaining skill that they need to go through in REP.
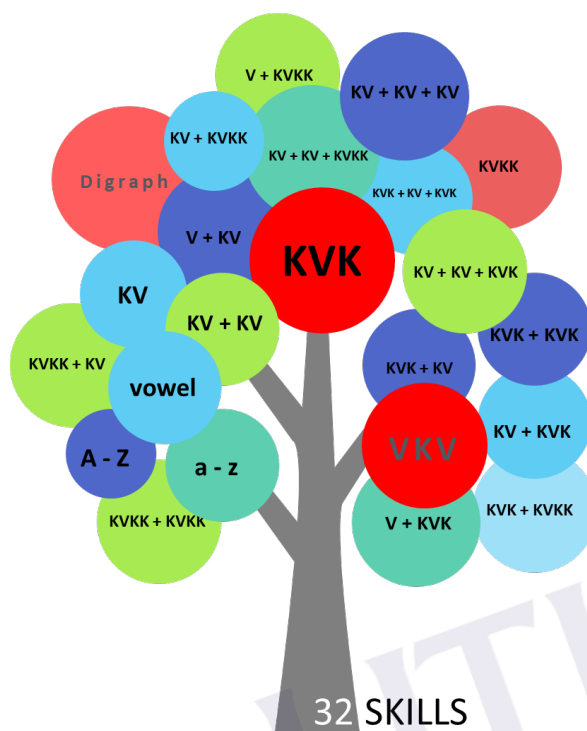
Figure 1.5: Example of the thirty-two skills based from the T&L Guidebook Bahasa Melayu [19].

Due to the RSs struggling to master the specific and basic skills like *KVK, KVKK, VKV* and Digraph in Bahasa Melayu, the researcher has come out with the idea of developing an AR learning application which is called Remedial Module Augmented Reality (ReModAR). This ReModAR application has been integrated with cloud-based systems.

Figure 1.6 and 1.7 shows the analysis data from the remedial teachers of RSs all over Batu Pahat in 2019 that are enrolled in REP and each of them are categorized in class of Bahasa Melayu (BM), Mathematics (MT), Bahasa Melayu with Mathematics (BM & MT) and the overall group. Figure 1.6 shows the data was collected based on remedial students of 1st to 3rd year in primary school, it shows the highest number enrolled in each category compared to number in Figure 1.7. This shows that in 1st to 3rd year in primary school there are a lot of students that are reported to have 3M issues. Different in Figure 1.7, it shows the collected data for 4th to 6th year students in primary school. The data shows the remaining RSs that are still unable to fully master the 3M, this brings concern to not just the teachers but also the

RS's parents due to this will affect RSs' learning capability when they enter high schools.
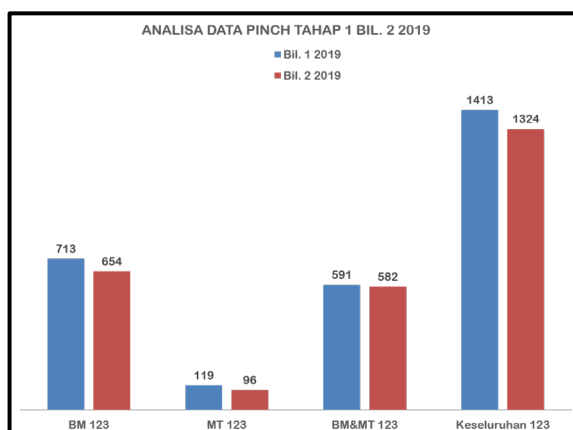
Figure 1.6: The statistic of RSs in level 1 [20].
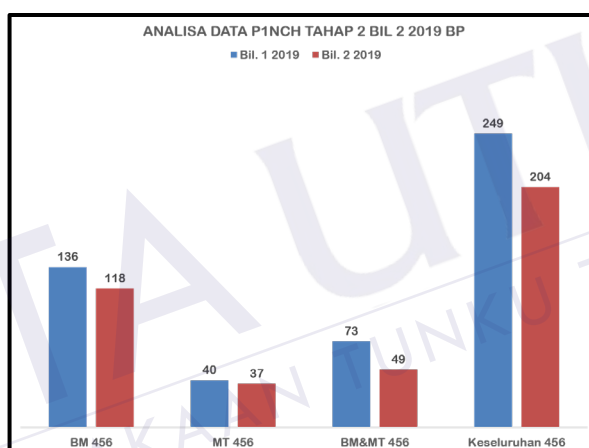
Figure 1.7: The statistic of RSs in level 2 [20].

Blue Bar = First evaluation, Red Bar = Second evaluation

1.3 Research Questions

Based on the problem statement of the research, the following research question are posed:

 (i) What are the suitable learning activities based on KVK, KVKK, VKV and Digraph skills for remedial students?
 (ii) How to help remedial students to stay focus in learning?
 (iii) Is there any difference between conventional methods approach and ReModAR applications in terms of student performance?

1.4 Research Objectives

The objectives of this research are as follows:

(i) To identify suitable learning activities based on KVK, KVKK, VKV and Digraph skills for remedial students.

(ii) To develop Remedial Modul Augmented Reality (ReModAR) application for remedial students.

(iii) To compare the effectiveness of the ReModAR application with conventional methods.

1.5 Research Scope

The scope of this research is based on the objective. By using a certain tool of software and hardware that is applicable to develop the ReModAR application for the RSs. The software tools that are suitable for this type of development for the ReModAR application is the Unity 3D and Vuforia SDK to use image target features as card games for AR based for the activities in *pembelajaran* mode. There are two modes for the activities of the ReModAR application which are to learn the image object based on the AR image target on the card game and to familiarize with the drag & drop gameplay inside quiz mode. The function of displaying score marks and saving them has been introduced successfully. Aside from that, the saved marks are then stored in the cloud storage. Each mode has the same number of skills that cover *KVK, KVKK, VKV* and Digraph.

The Blender software is used to create or design 3D objects in *pembelajaran* mode, while the MySQL database is used for cloud storing of score marks in *pengujian* mode. After completed developing the ReModAR application, the android OS smartphone is used as the hardware part to test and run the application. Finally, the ReModAR application was tested and analysed on three RSs in each of six selected schools in Batu Pahat, Johor. To analyse the effectiveness of ReModAR application towards RS, a questionnaire is given to the remedial teachers to identify based on the review and comment whether the ReModAR application is proven to be effective when testing at the RS and the comparison results between conventional learning material

(card puzzle box) with ReModAR application. The data results are based on the total amount of time it took to answer all of the questions in seconds. The scope summary is depicted in Figure 1.8.
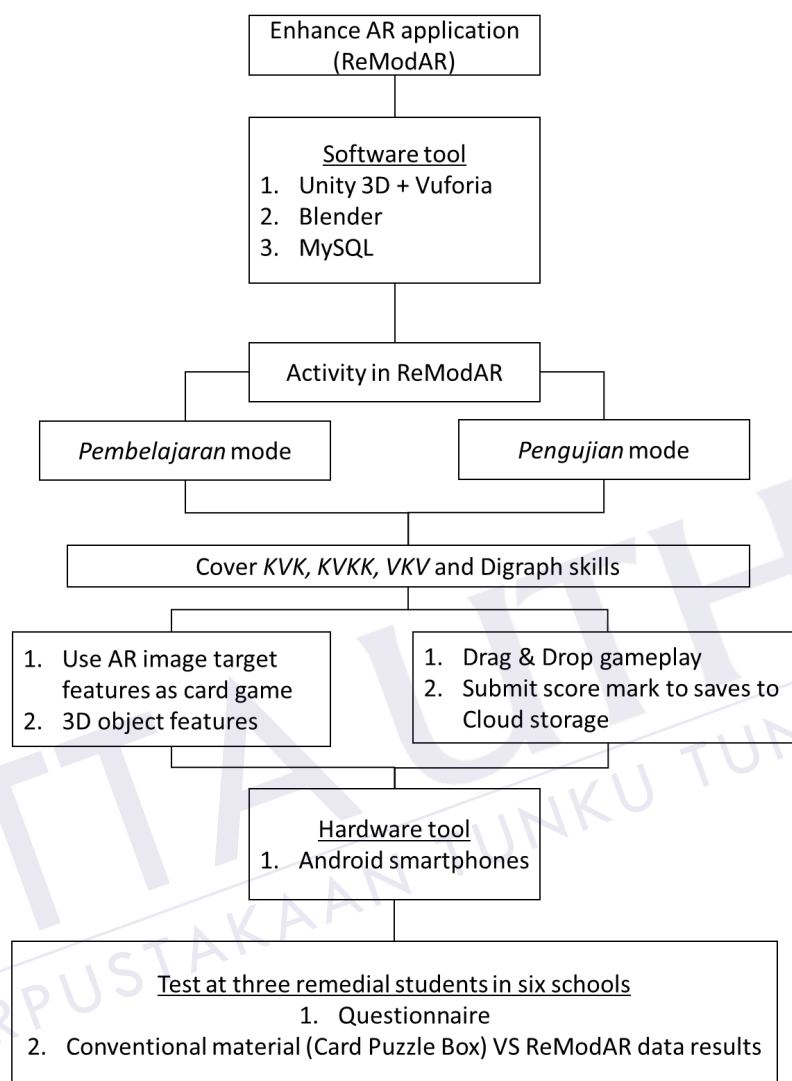
Figure 1.8: Scope of work.

The work is complete after fulfilling the activities as follows:

(i) The suitable learning activities on *KVK, KVKK, VKV* and Digraph skills for remedial students are applied.

(ii) The development of ReModAR application are successful.

(iii) The effectiveness ReModAR application are proved when compare with conventional method.

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APPENDIX I

VITA

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