



Faculty of Computer Science and Information Technology

Mobile Learning for Mathematics
(Mathematics Solver Application)

Malcolm Ligong anak July

Bachelor of Computer Science with Honors (Multimedia Computing) 2020

Mobile Learning for Mathematics
(Mathematics Solver Application)

Malcolm Ligong anak July

This project is submitted in partial fulfilment of the
requirements for the degree of Bachelor of Computer Science with Honors (Multimedia
Computing)

Faculty of Computer Science and Information Technology

UNIVERSITI MALAYSIA SARAWAK

2020

PEMBELAJARAN MENGGUNAKAN TEKNOLOGI MUDAH ALIH UNTUK SUBJEK
MATEMATIK
(APPLIKASI PENYELESAIAN MATEMATIK)

Malcolm Ligong anak July

Projek ini merupakan salah satu keperluan untuk
Ijazah Sarjana Muda Sains Computer dengan Kepujian
(Pengkomputeran Multimedia)

Fakulti Sains Computer dan Teknologi Maklumat
UNIVERSITI MALAYSIA SARAWAK 2020



FACULTY OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY
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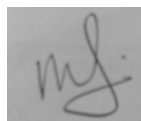
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Abstract—Mathematics is one of core subject that student have to learn in school. However, learning mathematics need lots of time to study as students have to do lots of exercise to do well in mathematics. This project give solution on helping student to learn mathematics outside the school with help learning application. The application have function to scan the questions using camera, drawing board to write the questions and text field to type the questions. However, for using functionality of the scanning the questions using camera only work for printed questions as the application cannot recognised the handwriting while drawing board to write the questions can be used as remove the image noises when using the camera to scan the questions. The answer of the questions will be shown after the user click calculate button.

Abstrak — Matematik adalah salah satu subjek teras yang mesti dipelajari oleh pelajar di sekolah. Walau bagaimanapun, belajar matematik memerlukan banyak masa untuk belajar kerana pelajar harus melakukan banyak latihan untuk melakukannya dengan baik dalam matematik. Projek ini memberi penyelesaian untuk membantu pelajar belajar matematik di luar sekolah dengan bantuan aplikasi pembelajaran. Aplikasi ini berfungsi untuk mengimbas pertanyaan menggunakan kamera, papan gambar untuk menulis soalan dan bidang teks untuk mengetik soalan. Walau bagaimanapun, untuk menggunakan fungsi mengimbas soalan menggunakan kamera hanya berfungsi untuk soalan bercetak kerana aplikasi tidak dapat mengenali tulisan tangan sementara papan lukis untuk menulis soalan dapat digunakan sebagai menghilangkan kotoran gambar ketika menggunakan kamera untuk mengimbas pertanyaan. Jawapan bagi soalan akan ditunjukkan selepas pengguna mengklik butang hitung.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

In Malaysia, there 2 level of curriculum, which is primary education and secondary education. Based on the Ministry of Education Malaysia, primary education takes 6 years and children usually started their primary education from ages 7. At end of their studies in Year 6 (12 years old), they will sit for the Ujian Penilaian Sekolah Rendah (UPSR) which will test them in comprehension, writing and oral for Malay and English, in Mathematical skills, and in science concepts. After UPSR, students have the opportunity to further their studies in secondary school. Secondary education is divided into two stages, lower secondary education (form 1 to form 3) and upper secondary education (form 4 to form 5). At the end of Form 3, students will sit for Pentaksiran Tingkatan Tiga (PT3) which will test them in Bahasa Malaysia, English, Science, Mathematics, History, Geography and Living Skills (Kemahiran Hidup). In upper secondary school, students typically attend one of three types of schools, Academic (arts or science stream), Technical and Vocational (technical, vocational or skills training stream) and Religious. All students from these types of school have to take 4 core subjects; Bahasa Melayu, English, mathematics, Islamic studies or moral education and history (Nick Clark, 2014).

In primary and secondary education in Malaysia, mathematics is one of the core subjects that every student have to take. Former Prime Minister of Malaysia, Tun Dr. Mahathir said that Mathematics and Science are important subjects that should be learned in English for development of the country (The Sun Daily, 2015.) That the reason why the Malaysian government for the past decades has put emphasis on Science, Mathematics, and Technology in education. (Ministry of Education. 2004.). The deputy of Ministry of Science, Technology, and Innovation, Datuk Dr. Abu Bakar Mohamad Diah, worried when he found out that the number of students who continue their studies in third level education in science and technology field not achieving the government's target was not fulfilled. The government target ratio 60:40 for students who continue their studies in science and technology field, however, the ratio students who continue their studies in science and technology field was 20:80, opposite result on what was targeted in Hala Tuju Modal Insan Sains dan Teknologi: Menjelang 2020 (Bernama, 2017). He mentioned that this field is important for the development of the country's economy. However, most of the students learn in school where

their teacher only spend one or two hours to teach them in school. So, the students have to study independently after school. For students who have educated parent or guardian with them after school, they can ask for their help to study mathematics. However for the student, who have uneducated parent or guardian with them after school, they have difficulties to ask for their help to solve the mathematics problems. And to learn mathematics independently is difficult for some students. Nowadays, with the industrial revolution 4.0 (IR 4) trending, there many ways for students to get better in the study. They can ask from online discussion or forum, websites, and software or application to study. In this way, students can spend their time efficiently to study mathematics.

1.2 Problem statement

SIJIL PELAJARAN MALAYSIA TAHUN 2017 DAN 2018
ANALISIS MATA PELAJARAN DAN GRED PURATA MATA PELAJARAN (GPMP)
 (Semua Calon Baharu yang mendaftar sekurang-kurangnya enam mata pelajaran)

Kod	Mata Pelajaran	Tahun	Peratusan Calon					Bil. Duduki	GPMP
			Cemerlang A+, A, A-	Kepujian B+, B, C+, C	Lulus DE	A+→E	Gagal G		
1103	Bahasa Melayu	2018	31.9	44.1	17.4	93.4	6.6	390,708	4.19
		2017	32.8	44.0	16.7	93.5	6.5	413,985	4.11
		Beza	-0.9	0.1	0.7	-0.1	0.1	-23,277	0.08
1119	Bahasa Inggeris	2018	14.4	30.6	34.4	79.4	20.6	388,899	5.98
		2017	16.5	29.8	33.6	79.9	20.1	412,308	5.84
		Beza	-2.1	0.8	0.8	-0.5	0.5	-23,409	0.14
1223	Pendidikan Islam	2018	30.4	50.2	7.9	88.5	11.5	224,409	4.18
		2017	30.1	50.9	7.4	88.4	11.6	236,950	4.18
		Beza	0.3	-0.7	0.5	0.1	-0.1	-12,541	0.00
1225	Pendidikan Moral	2018	25.6	44.0	11.5	81.1	18.9	124,637	4.81
		2017	26.7	43.6	10.8	81.1	18.9	136,851	4.75
		Beza	-1.1	0.4	0.7	0.0	0.0	-12,214	0.06
1249	Sejarah	2018	23.1	40.5	23.9	87.5	12.5	389,093	4.98
		2017	19.9	41.0	24.9	85.8	14.2	413,314	5.23
		Beza	3.2	-0.5	-1.0	1.7	-1.7	-24,221	-0.25
1449	Mathematics	2018	31.2	24.9	25.9	82.0	18.0	388,742	5.03
		2017	31.5	25.2	25.7	82.4	17.6	411,221	4.94
		Beza	-0.3	-0.3	0.2	-0.4	0.4	-22,479	0.09

Figure 1.1 (Pengumuman Analisis Keputusan Sijil Pelajaran Malaysia (SPM) 2018)

In Figure 1.1, there six subjects that students take in SPM. However, this project mainly focused on mathematics. In 2018, the students performances in mathematics slightly dropped compared in 2017. The percentage of failed students increased by 0.4%. While the percentages not seem too concerning, the percentage of students get credit in Mathematics were dropped. For students who wished to continue their studies in higher education, most of IPTA required students to get credit or grade C and above for students furthering their studies. From the figure above, we can found out that mathematics are the subject are hard to master. This can found out from the percentage of student get D and E increased in 2018 compared to 2017. The mathematics is one of the subjects that students feel that subject that they were difficult to master even they learn mathematics from young age. To help their children to get better in mathematics, the parent sends their kids to tuition centre. However, for the parent who unable to spend money on their children tuition' fees due to some difficulties, they have to figure out the alternatives ways. This project show an alternative ways to help the students to learn mathematics. By using this application, they can reduce their time for idling to search the solution. And they also can learn mathematics anytime and anywhere they want to learn mathematics as this application developed in mobile devices which is flexible.

1.3 Objective

Students who have difficulties to study or doing their homework or exercise given by teacher need to have better ways to help the students to study. Objectives of this project are

- To design a mobile application to assist students in learning mathematical concepts.
- To develop a learning application for Android platform.
- To test the functionality and usability of the system.

1.4 Scope

The scopes of this project are as follow:

- This application is specially design to solve mathematical problems involving mathematics operations for integers, fractions and decimals, linear algebra, graphs and

geometry for students who taking Ujian Penilaian Sekolah Rendah (UPSR) and Pentaksiran Tingkatan Tiga (PT3).

- The application is developed for Android platform.
- The application is focused on solving the mathematics problem given to the user.

1.5 Brief methodology



Figure 1.2 the structure of the traditional model and the RAD model

Application development usually more time consuming than doing researches. We should have a proper selection on the methodology used, if the time is more crucial than the cost RAD model is preferred, and RAD model can be used when the requirements are not clear. For this project achieves its objectives, using RAD more suitable than using the sequential method given a short time provided to complete the project (Mone, 2015). Figure 1.2 shows the structure of the traditional model and the RAD model. RAD model is divided into 4 main phases, analysis and quick design, prototype cycles, testing, and implementation.

1.5.1 Analysis and quick design

The analysis phase is important phases before the development of application starts. The targeted user's environment has to consider to avoid difficulties for the user to use the application. The IT knowledge of the user also has to consider too. The design phase also important as the design has to be friendly user to allow the user to use the application easily.

1.5.2 Prototype cycle

Prototype cycle is a crucial phase for application works without errors. From the prototype cycle, we can figure out the problem before the implementation of the application. The feedback from demonstrates the application also important to know the lacklustre of the application.

1.5.3 Testing

During the testing phase, we find out whether the code and programming work according to targeted user requirements. During this phase, we can find out the problems that occur and reduce the errors as much as possible.

1.5.4 Implementation

After the testing phase carried out without any problems occurs, the application will be deployed into Google Playstore for the user to install in their devices.

1.6 Significant of project

The main purpose of developing application for mobile learning for mathematics is to introduce an alternative way for primary school students to learn mathematics. This application is developed in Android mobile devices, where the students can learn mathematics at anytime and anywhere. The students will use this application as one of their learning tools.

1.7 Schedule

Refer to appendix A and appendix B in page 66

1.8 Expected of outcome

Mobile Learning for Mathematics will have many features that can attract students for using it and applying it to learn mathematics anytime they want. This because this application will be design to show the solution to the question they having problems. This application will reduce the time for student idling to search the ways to solve the questions. This application also shows record which type of questions they having problems to solve. This record can be used to see the student weakness in mathematics in order to improve the students' knowledge in mathematics by providing the video tutorial on how to solve the questions.

1.9 Project Report Outline

Chapter 1: Introduction describes the introduction of the project in details. The contents included in this chapter are separate into eight section which are the title, introduction, and problem statement, objectives, scope, and methodology, significant and expected outcome of this project. This project is proposed to solve the problem stated and introduce a new way for primary school students and lower secondary school to learn Mathematics.

Chapter 2: Literature Review reviews and analyses the existing similar AI application. From the application reviewed in this chapter to obtain the features and functions which are suitable to be implemented in the proposed application. The comparison between the existing applications and the proposed application is highlighted to measure the differences between applications.

Chapter 3: Requirement Analysis and Design describes the methodology used to develop this project. The ways to collect and gather the requirements are presented and the responses are analysed. Other than that, the flow of the project is explained in this chapter through UML diagrams and the prototype of this project.

Chapter 4: Implementation highlight on the implementation of the application. There are several scenes contained in this application and are discussed separately with the aid of the actual user interfaces in this chapter.

Chapter 5: Testing emphasizes on the testing of functionality, user acceptance and feasibility of this application and evaluation of the test results. The testing includes the system testing tested by the developer, pre-test and post-test and usability testing tested by the user.

Chapter 6: Conclusion and Future Work describes the achievements and limitations of the application implemented. Other than that, the enhancements that can be done to this application is also discussed as the future work to make the application more attractive.

Chapter 2: Literature Review

2.1 Introduction

The first part of this section discussed the roles of mobile learning for education. The following part is a review of three related works on mobile learning for mathematical learning; PhotoMath, Socratic and Math 42. All these examples were implemented for mobile learning in the Android and iOS platform. The review starts with the introduction of the system, the benefits of the system and the summarization of the features of the reviewed system.

2.2 Mobile Learning for Education

Mobile technology is one of the technology advances that are considered to be one of a new paradigm of education nowadays. This utilization of mobile devices in education is mostly referred as mobile learning (L. Chmiliar, 2010.). Mobile learning emerged in response to the need of ubiquitous and ‘on-the-go’ access to learning which completes the missing puzzle in face-to-face classroom. With the use of mobile devices such as mobile phone and smart phone, mobile learning is gaining popularity in its ability to facilitate teaching and learning activities, such as monitoring students’ performance (S. Mahamad, 2008.) and disseminating learning contents [T. Lim, 2011.]. One of positive effect of mobile learning is the increasing usage of mobile devices among the younger generation. The report made by Malaysian Communication and Multimedia Commission (MCMC), stated that the penetration rate of mobile in Malaysia for the year 2010 is 106% , which implies multiple subscriptions among user.(Malaysian Communications and Multimedia Commission (MCMC), 2010).

One of the keys ways for mobile learning will impact education is through the application of greater individualized learning (Smith.S, 2016). Students spend their time in school around 5 to 6 hours and mostly they use their time outside of the school for independent learning. Some of these students study using alternative ways such as using adaptive learning programs, games, and software. These systems respond to the need of the student as they put greater emphasis on certain topics, repeating things that students have not mastered and helped them to work at their own pace.

As every human have their own biorhythm, student able to learn efficiently by using their favourite time to study (Kharkovyna, O, 2018). Some people might feel better in the study at night as being called night person and there also feel better in the morning to study called morning person. As we know that the machine does not need a break, the mobile application helps students to study efficiently because of the application able to respond to their problems in studying anytime they want to study.

In the future, mobile learning will have a profound impact on education systems. This is not because of the characteristics of mobile learning but mobile learning is one of an ongoing broader transformation that results from digitalization, real-time networking of communication and production and automation of productive processes (Tuomi, 2018). Not only that but the mobile learning also able to be one of the factors on developing new technologies. By using mobile learning, they able to use their time efficiently and able to use the leisure time on producing new ideas of the technologies efficiently. Not only student has the benefit of mobile learning but teachers and parents also able to gain benefits too. They are able to reduce their time on grading their homework or test and use their time working on their professional development and interacting with students.

2.3 Review of Similar Existing System

2.3.1 PhotoMath

Photomath is a mobile application available for Android and iOS platform and can be download in both GooglePlay and App Store (Elliott, M, 2014). This application developed by Photomath.Inc and released in 2014. PhotoMath is a free mobile app that can read and solve mathematical expressions using the smartphone camera in real time.

The app also provides a step-by-step guide showing how each of the problems is solved. The step-by-step guide is beneficial to students that do not have access to a tutor and struggle with solving mathematical problems. The PhotoMath application uses optical character recognition (OCR) technology to read the equation and calculates the answers within seconds. There is a red frame in the PhotoMath app that you have to use to capture the equation.

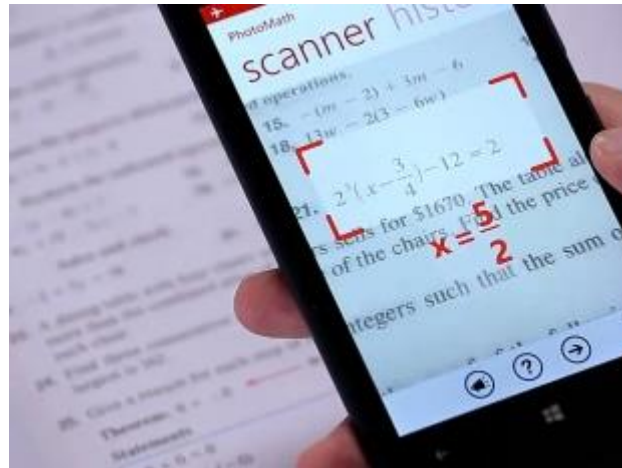


Figure 2.1 PhotoMath read the equation.

However, this application has its own limitations. The application has trouble reading the handwriting equation as there are variations in human handwriting. The application might be captured the “x” as the multiplication sign. But this problem can be solved by writing “x” as “x” as the application able to detect X by the edge of the alphabet. This application was also able to record the question that is asked for parents or teachers to know their progress. This approach also able for teachers or parents to know the student's weakness by seeing the questions that frequently asked. In Figure 2.2, the application took the image of the equation to solve the mathematical problems. The equation must be in the red box in the application so that the application able to recognize the question and record the questions in the database as shown in Figure 2.2. The record of the question can be monitored by teachers or parents to see the progress of student in study. Not only has that, they also able to know the students weakness based on the frequency of type questioned that being asked.



Figure 2.2 The record of the equation being scanned

2.3.2 Socratic

Socratic is a mobile application available for Android and iOS platform and can be download in both Google Play and App Store. This application developed by Chris Pedregal and Shreyans Bhansali in the United State of America and released in 2013 (Crunchbase, 2013). This application target middle school and high school students in United States of America. Socratic cover up 4 subjects: Science, Mathematics, Social Science and Humanities, and each subject cover up some subtopic.

In Science subject, Socratic cover up subtopic of

- Anatomy and Physiology
- Astronomy
- Astrophysics
- Biology