M-learning application for PT3 Mathematics (Solid Geometry)

BY

GOH SHIN YEAN

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION SYSTEM (HONS) INFORMATION SYSTEM

ENGINEERING

Faculty of Information and Communication Technology

(Perak Campus)

MAY 2015

UNIVERSITI TUNKU ABDUL RAHMAN

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DECLARATION OF ORIGINALITY

I declare that this report entitled "M-learning application for PT3 Mathematics (Solid Geometry)" is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

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Name : _____

Date : _____

Acknowledgements

By successfully completing this project, I would like to express my thanks and appreciation to my supervisors, Dr Doris Wong Hooi Ten. Thanks for all the guidance and suggestion throughout the whole development process.

Abstract

With the rapid development of ICT, the application of e-learning have become more commonly used in education. It is a great potential to implement mobile application in learning process when MOE started to allow students to bring their mobile phone to schools. This project will develop an M-learning application for PT3 Mathematics (Solid Geometry) for lower secondary school students Malaysia. Learning through Interactive Multimedia enable students to learn with their own pace as well as improve their learning rate.

This project will create an interactive learning environment and ensure that the content is fit with the school syllabus so that students wouldn't confuse with what they had learnt in the school. This free access learning courseware are expected to become alternative learning tool for students despite reference books. Also, the application will focus on the user friendliness to ensure learners won't be hassled by the operation of the application itself to have better learning experience.

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LIST OF ABBREVIATIONS

MSC	Multimedia Super Corridor
MOE	Ministry of Education Malaysia
ICT	Information & Communication Technology
UI	User Interface
ADDIE	Analysis Design Development Implementation Evaluation
ISD	Instructional System Design
RAM	Random Access Memory
APK	Application package file
M-learning	Mobile Learning

CHAPTER 1 INTRODUCTION

Chapter 1 Introduction

1.1 Background

There is a popular movie quote saying that *mathematics is the language of nature* (Pi, 1998) which expressed how important mathematics are in human daily life. Mathematics not only about calculation, a simple if and else statement would involves logical reasoning as well. Therefore, mathematics skill is indispensable to produce a high order thinking young generation.

Smart school are one of the 7 flagship applications included in the Multimedia Super Corridor or MSC. One of the smart school application that commonly used in Malaysian schools recent years are the multimedia learning courseware. The interactive multimedia courseware prepared by Ministry of Education Malaysia was distributed to all the schools with the intention to improve students learning ability and improve teachers teaching performance. Students whom relatively week in mathematics able to understand the subject concept easily with the help of multimedia visualisation.

The evaluation of mobile devices change the style how Malaysian deal with their daily life, including learning. M-learning or mobile learning enable m-learners to learn through their mobile devices, anyplace and anytime. The mobility and portability of handheld devices bring lots of convenience to the learners as the learners can explore to the virtual learning material without the need of bringing traditional books all the way. Apart from that, m-learners can access to more knowledge on the internet through the network connectivity of the mobile devices.

Although there are many negative perception towards the topics learning and teaching through mobile phone however, it should be encourage because it is not aims to replace traditional classroom activities but to enhance the learners learning experience.

CHAPTER 1 INTRODUCTION

1.2 Problem Statement & Motivation

1.2.1 Content do not designed according to Malaysia's secondary school context

Despite the multimedia courseware prepared by Ministry of Education Malaysia, the mathematics learning application currently available in the market are not designed according to the Malaysia's school context. The different syllabus adopted by might confuse students with what is being taught in the school.

1.2.2 Limited user interaction.

The current e-learning application allow limited user interaction. Some of them even do not provide user the ability to control over the content. Video are the most common e-learning medium whereby it only allow one way communication without user interaction. Passive learning process without user involvement are not effective as compare to active learning process in terms of knowledge absorption.

1.2.3 Learning application available in the market are not free.

In most cases, a complete and high usability as the development cost of multimedia project is always higher than conventional teaching material. Students or parents have to pay some amount of purchasing or subscription fees in order to use it. This extra expenses stop the students from having chances to access to the learning application which will bring them so much advantage in learning process.

1.2.4 Limitation of traditional teaching way

In the traditional classroom, students not able to repeat their teachers words after the school hour. Students only able refer to the hard copy such as books and notes without live demonstration. For some students, learning math without explanation and demonstration on the solution makes them feel difficult to learn.

1.2.5 Less Mobility

Many learning application available in the market are presented in either CD-ROM which required a computer to run the program or in web. Students need to have a computer or internet connectivity in order to access to the application.

1.2.6 Less User Friendliness

CHAPTER 1 INTRODUCTION

Some learning application available does not focus on the user friendliness for example the learning content is not accessible or not viewable. In addition, user have to try hard to look for certain content without the help of proper navigation tools.

CHAPTER 1 INTRODUCTION

1.3 Project scope

       The M-Learning application focus on lower secondary school mathematics subject to provide students a self-directed learning environment. The target audience for this project are Malaysia's lower secondary school students whom ages from 13 to 15 years old. English language will be the transmission language used by this applications. In consideration of the bilingual mathematics learning environment practiced by some secondary schools, this application will include a list of glossary in English and Malay Language. This application is developed for android phone.

       The mathematic topics selected in this project are solid geometry related chapters which includes the following chapters:

- Form 1 Chapter 12 - Solid Geometry (I)
- Form 2 Chapter 12 - Solid Geometry (II)
- Form 3 Chapter 8 – Solid Geometry (III)

The chapter's content will discuss on the introduction to solid geometry, area of solid geometry and volume of solid geometry.

       There will be a total of 6 modules in this application:

- Lesson
- Exercise
- Formula
- Glossary
- Calculator
- Discussion Board

Detail of the modules will be discuss in Chapter 3.

CHAPTER 1 INTRODUCTION

1.4 Project Objective

1.4.1 Learning content according to Malaysia's lower secondary school context

The project main objective is to create the learning content according to the subject guidelines from Ministry of Education Malaysia so that the content will make sense to target audience.

1.4.2 Allow user interactivity

Another objective are to create the learning courseware as an interactive multimedia presentation. Students are given the ability to select the chapter and topics they would like to study without the need of go through whole syllabus one by one.

1.4.3 Free access to all individual

Furthermore, this learning courseware provides free access to all individual. Students, parents or teachers can use this courseware without paying any extra cost.

1.4.5 Access to the courseware anytime at anyplace

In addition, this courseware allow students to learn anytime, anyplace as long as the mobile devices is ready with or without internet connectivity.

1.4.6 User Friendly

Lastly, this project will concern on creating an appropriate UI. User interface design is one of the most important aspect for any kind of multimedia presentation. User experience are greatly affected by the UI and navigational control of the system.

CHAPTER 1 INTRODUCTION

1.5 Impact, Significance and Contribution

At the end of this project, students able to access the free mathematics learning courseware that is fully compatible with the subject circumstance. It is believe that through this application, the mathematics learning process will become more interesting hence will motivate students to have active learning instead of passive learning. This courseware are expected to become a supplement material for students as preparation to PT3 examination apart from reference books.

1.6 Report Organization

This report consists of 7 chapter as below:

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: System Design

Chapter 4: Methodology

Chapter 5: Implementation

Chapter 6: Testing

Chapter 7: Conclusion

Chapter 2 Literature Review

2.1 Advantages of M-learning over traditional PC based E-learning

According to the research from Mahamad, Ibrahim and Mohd Taib (2010), there are some advantage of M-learning over traditional PC based E-learning while the most significant benefit are the mobility learning environment. M-learners own the freedom to learn at their own pace without the restriction of physical area and time constraint.

In addition, learning through mobile devices could provide a better and comfortable learning environment for the learners. The ease of use of the mobile devices give learners more confident when dealing with the mobile devices rather than the complexity of PCs that leads to the refusal of E-learning especially for those whom socially disadvantaged (Stead, 2005). The cost of learning are cheaper in terms of purchasing the hardware further decrease the barriers of learning digitally and encourage more learners to get themselves involve in M-learning.

CHAPTER 2 LITERATURE REVIEW

2.2 Teaching via Mobile Phone in Malaysia

According to a study from School of Distance Education Universiti Sains Malaysia by Ismail et al (2014) with 38 primary school teachers in Penang shows that the overall acceptance of technology in teaching and learning are positive. This result are concluded from four different component of studies, each components were assessed by different set of question. The result are says to be positive when the majority of the components return a positive results.

Table 2.1: Overall acceptance of mobile phone in teaching and learning.

Component	Explanation	Result
Awareness and motivation	How much awareness of the pro and cons by the respondents towards M-learning and would it be the motivation of applying m-learning in teaching.	Positive
Training and courses	Willingness of the respondent to attend related training and courses of applying M-learning in teaching.	Positive
Training Design	Teachers agree that training related to mobile-learning technology that matches their needs will further improve their acceptance towards M-learning.	Positive
Support and Facilities	The sufficiency support and facilities provided to the teacher affect the acceptance towards teaching through mobile devices.	Positive

CHAPTER 2 LITERATURE REVIEW

2.3 Smartphone Operating System

There are quite a few numbers of smartphone operating system available in the market for example, the well-known OS includes: Android, iOS, Windows Phone and BlackBerry. Among these different smartphone platform, Android dominates 83.6% of the global market share, follow by iOS 12.3%, Windows Phone 3.3% and BlackBerry 0.7% in Q3 2014 (Yadav, 2014).
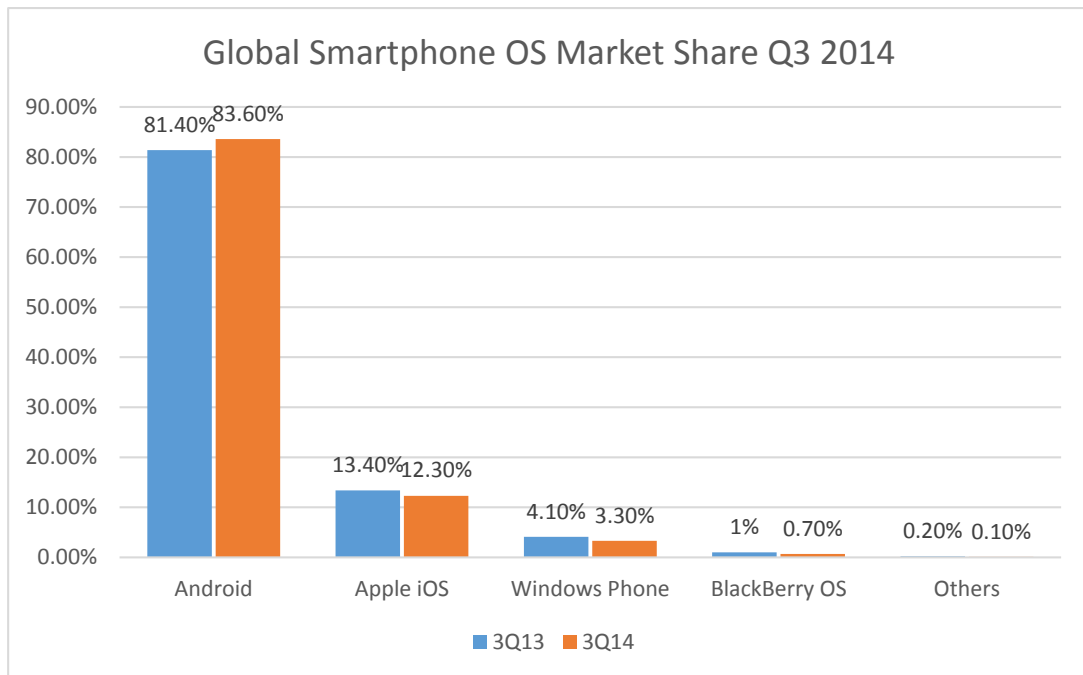
Figure 2.1: Global Smartphone OS Market Share Q3, 2014 (Strategy Analytics, 2014)

2.3.1 Android

Android is an open source operating system founded in year 2003 and supported by Google. It is used by different hardware vendor such as HTC, Samsung, XiaoMi, HuaWei and etc. It supports its native pre-build application as well as third party application via Google Playstore. Within the short period of 6 years, it becomes the global bestselling smartphone operating system in years 2010, about 27% (Tofel, 2010). Android market share growth drastically in past few years with the strong competitive from China's mobile phone firms which adapt android in their low-range and mid-range products (Yadav, 2014). The current version of android is Android 5.0, Lollipop. Android application can be developed in different environment such as Windows, Linux and Mac OS and it only requires USD25 one-time fee to register as developer in Google Play.

2.3.2 iOS

iOS is a mobile platform developed by Apple Inc which its first released in year 2007 where by it is limited to Apple hardware only for example, Iphone and Ipad. Apple doesn't produce budget device and Iphone always be the most expensive mobile phone in the market become a barrier for user to use this platform. Users are allowed to execute third party native application downloaded from App Store. In order to develop and publish application to App Store, developers will at least required to own a Mac machine and join iOS developer program by paying USD100 every year. The current version of iOS is iOS 8.

2.3.3 Windows Phone

Windows Phone or WP is a mobile operating system driven by Microsoft Cooperation. The first product using WP was released in year 2009. In year 2011, Microsoft and Nokia started their partnership by making Windows Phone as the man operating system for Nokia product, and it was hoped to replace Symbian which its market share had been greatly decrease when more user switch to its competitors, iOS and Android. Microsoft acquired Nokia Mobile Phone division in year 2014 and rename it as Microsoft Mobile to have a better collaboration between hardware and software. User can download and install third party application from Windows Phone Store. Windows Phone developer require to pay once-off registration fee USD19.99 starts from September 2014 instead of USD99 every year. The latest version of Windows Phone is Windows 10 Mobile which is design to be a counterpart of Windows 10 operating system.

2.4 User Interface Design

2.4.1 Ten Usability Heuristics for User Interface Design

According to a study by Faghih and Reza Azadehfar on the user interface design, user interface design plays an important role in e-learning software to the extent that the learning objective wouldn't be achieved even the software content are well selected because psychological factors are one of the reason to affect one-self learning performance(2013). A good user interface design for e-learning software should always refer to the principle proposed by Nielsen in the book Usability Engineering (1993). The 10 principle are known as Usability Heuristics because the rules is broad and with no specific guidelines.

CHAPTER 2 LITERATURE REVIEW

Table 2.2: Applying the theory of Usability Heuristics in the proposed courseware.

Principle	How it relates to the proposed courseware
Visibility of system status	The courseware should respond to the user immediately after user interaction to acknowledge user what is going on.
Match between system and the real world	The courseware should be delivered using the language and terms that students is familiar with rather than the technical word used by professional mathematician.
User control and freedom	The courseware should allow user to control the reading content and navigate freely along the different module.
Consistency and standards	The courseware should have a fixed layout container by which the position of the navigator are fixed. In addition, the other element used should be consistent as well.
Error prevention	The courseware should prompt a confirmation message when user click on the exit button.
Recognition rather than recall	The courseware should show the instruction whenever appropriate so that the user do not need to memorize the instruction.
Flexibility and efficiency of use	The courseware should be able to cater both week and strong students by allowing students to control their own learning pace without the necessity to follow the course structure.
Aesthetic and minimalist design	The courseware should only contain the knowledge which is relevant to the subject matter to avoid information overloading.
Help users recognize, diagnose and recover from errors	The courseware should suggest a constructive solution to the students whenever students answered the question wrongly.
Help and documentation	The courseware should include a help section or readme file.

2.5 Learning through Memory Game

2.5.1 Memory Game

Memory game also known as match match or pairs game. It is a card game that suitable for all ages. The game starts by laying all the cards facing down on the table or ground and two cards are flipped each turn. During the game, players take turn to flip up 2 cards at a time, the objective is to get a pair of matching cards. If the cards flipped is not identical, players have to turn the cards facing down again and let another players to flip the cards. The game ended when all the cards is facing up. Through this game, players has to use their memory to remember the cards' position also their intelligence to find out where is the cards (Pexeso.net, 2015).

Figure 2.2: Memory Card Game.
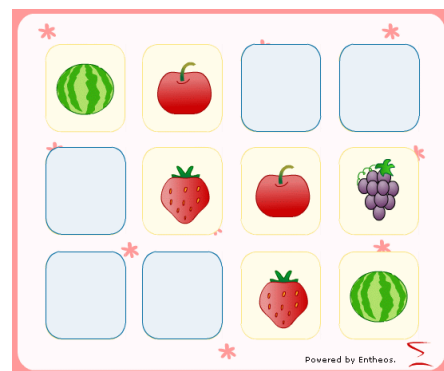
Figure 2.3: Digital Memory Game.

CHAPTER 2 LITERATURE REVIEW

2.6 Review of Mathematics Learning Courseware (Browser Based)

2.6.1 ICT Learning
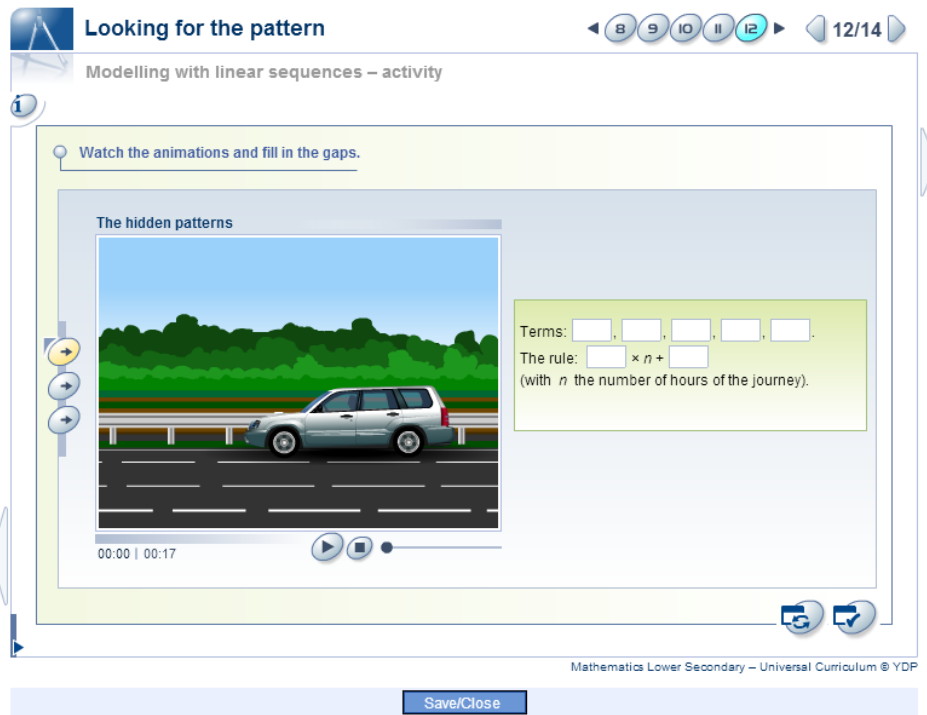
Figure 2.4: Screenshot of ICT Learning.

ICT Learning is a web based e-learning system that offer English, Science, Math and lifelong learning courses. User are required to pay for the content. Even though it is a Malaysia based company, but the Mathematics courses offered are based on universe syllabus instead of Malaysia's. For every chapter, students are recommend to access to the lesson first before the activity and revision exercise. Moreover, students are given the ability to control the presentation content through the navigation bar. Story and animation are provided to illustrate the lesson and with the help of narration, message able to convey in a clearer way. The courseware content are organized well with notes, graphic and animation to enhance students understanding.

2.6.2 One-school.net

Figure 2.5: Screenshot of One-school.net.

One-school.net is a free accessed Malaysia based e-learning website which gather notes, printable flashcard and exercise from the internet to Malaysia Form 4/ Form 5 students to understand the subject concept in Malaysia SPM Syllabus. The learning material are presented in text and graphic form without the integration of other multimedia element such as animation and audio. The printer friendly material enable students to print out the hard copy for future reference but it is not attractive because it is just an electronic version of a printable documents.

2.6.3 Teaching Courseware by Ministry of Education Malaysia
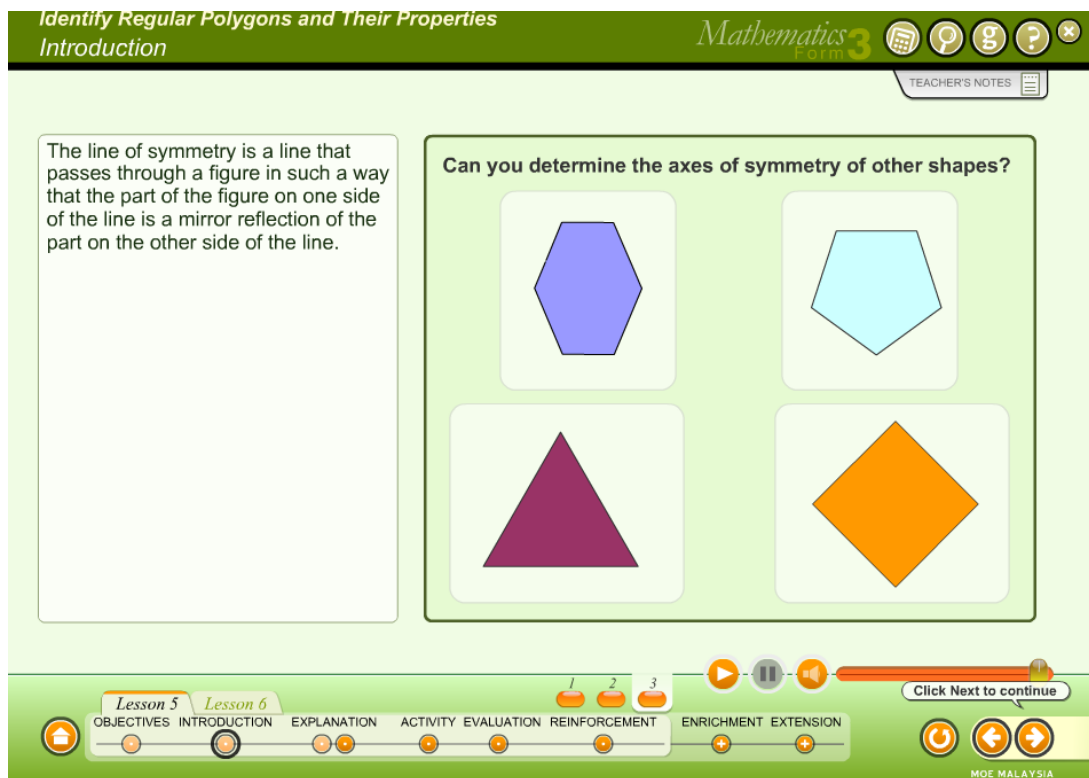
Figure 2.6: Screenshot of Teaching Courseware by Ministry of Education Malaysia.

The official teaching courseware prepared by the Ministry of Education Malaysia are says to be the most reliable courseware for students. Animation are provided to illustrate the lesson and with the help of narration, message able to convey in a clearer way. The courseware content are organized well with notes, graphic and animation to enhance students understanding. The suggested learning flow are as below:
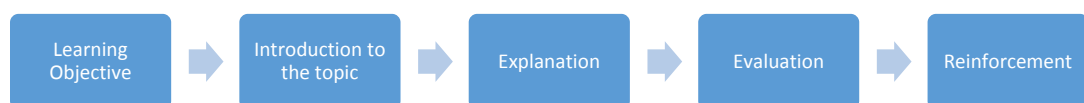
Figure 2.7: Courseware teaching flow by Ministry of Education Malaysia.

Students will first learn the theory and then practice the knowledge learnt. However, user are always given the ability to control the learning flow through the navigation bar.

CHAPTER 2 LITERATURE REVIEW

2.7 Review of Mathematics Learning Tools (Mobile Application)

All the reviewed application are downloaded from Play Store and executed in Android devices.

2.7.1 Solid Geometry
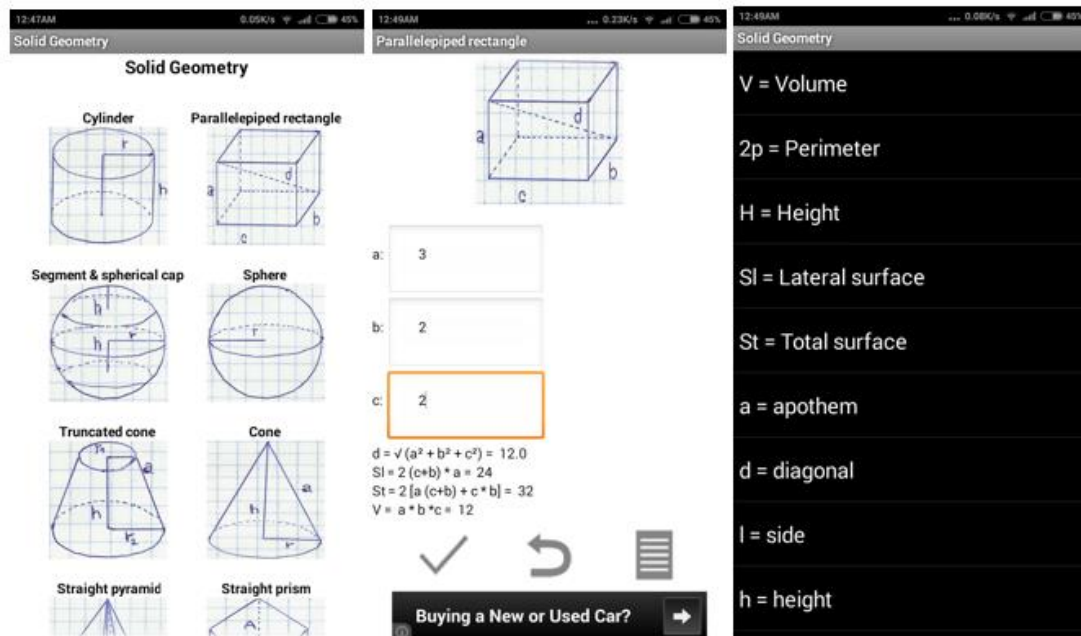
Figure 2.8: Screenshot of Solid Geometry.

The application Solid Geometry provides the formula and graphical overview of the solids. There is a build in solid geometry calculator in this application which allows user to calculate the diameter, area and volume of the selected solids. It doesn't not need internet connection to run.

2.7.2 PMR Free

PMR Free provides learners to review on the past year PMR papers for English, Malay, Mathematics and Science subject. Answer with solution is included in every question. The user interface designed is not friendly because sometimes the advertisement will appear above the content and the application content is presented by static graphic format where user have to zoom in to view clearly but at the same time some part of the content will not be viewable in the same screen. Internet connection is compulsory for this application to function.

CHAPTER 2 LITERATURE REVIEW
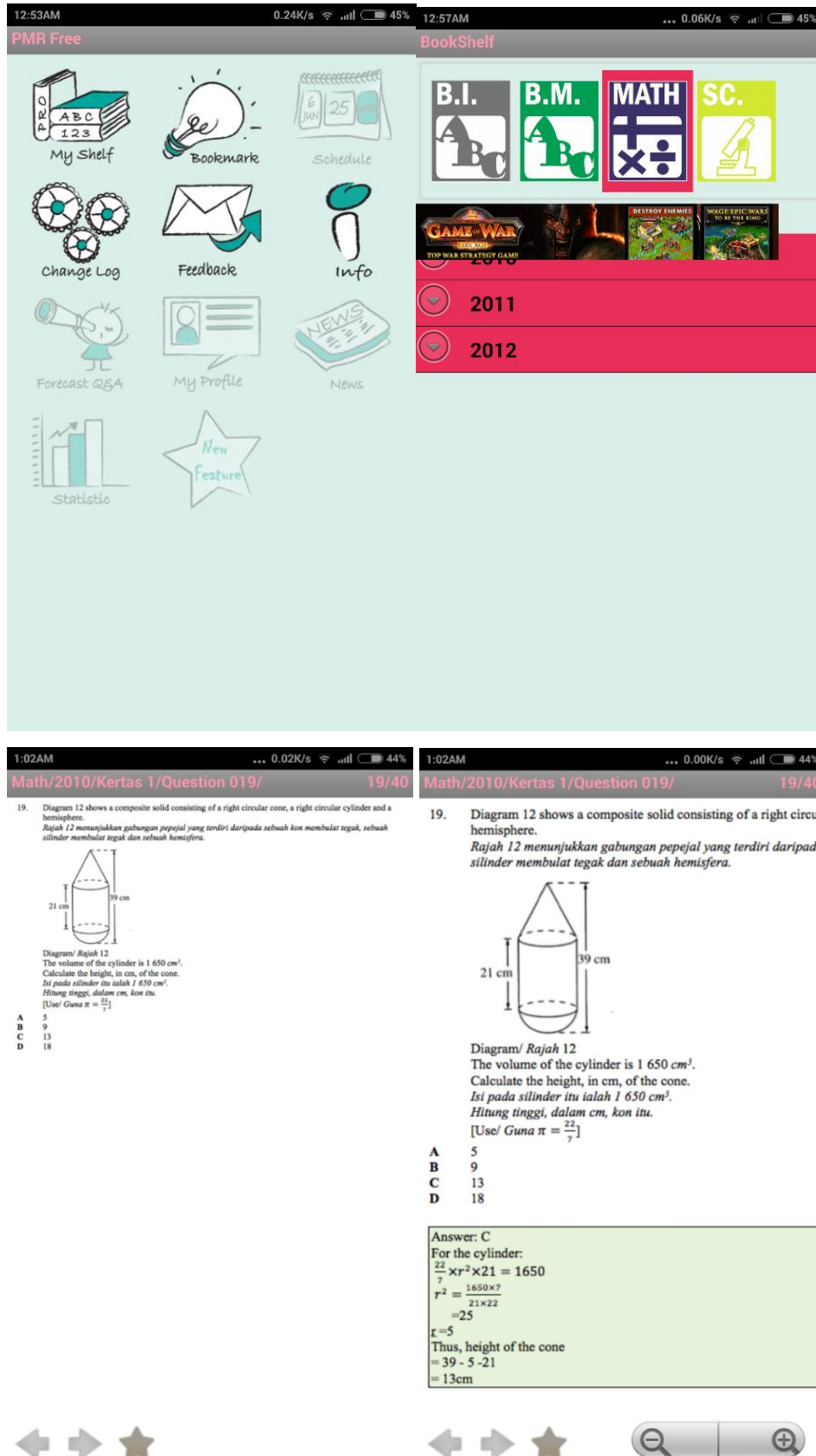
Figure 2.9: Screenshot of PMR FREE.

2.7.3 Guru App

CHAPTER 2 LITERATURE REVIEW

Guru App provide chapters by chapter's lesson for PMR and SPM subjects. The user interface for this app is good as the user can easily navigate to different part of the application through the navigation bar. The lessons are presented in video and slideshow however, the video and slide sourced from external parties like YouTube and Scribd will lead to content not accessible if the owner deleted the content. Guru App depends on internet connection heavily. Some of the features in Guru App is not function, for example the past year papers.
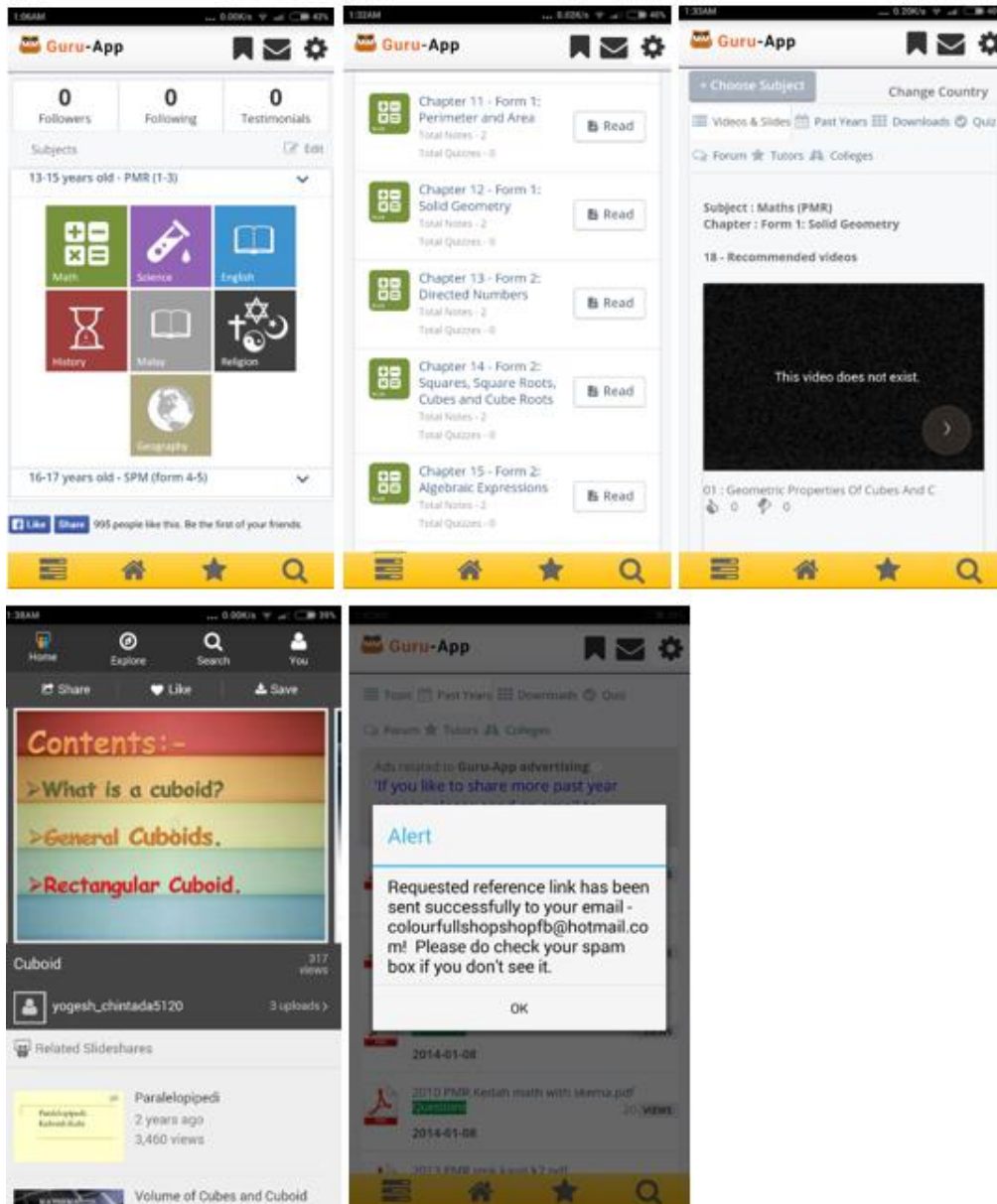
Figure 2.10: Screenshot of Guru App.

2.7.4 Complete Mathematics

Complete Mathematics provide text based learning content with some graphical aids. It doesn't require internet connection to launch the program, all the contents are store locally in the user's device. A calculator is built in in the application. The contents are design generally based on the subject matter which might not suitable for Malaysia students.
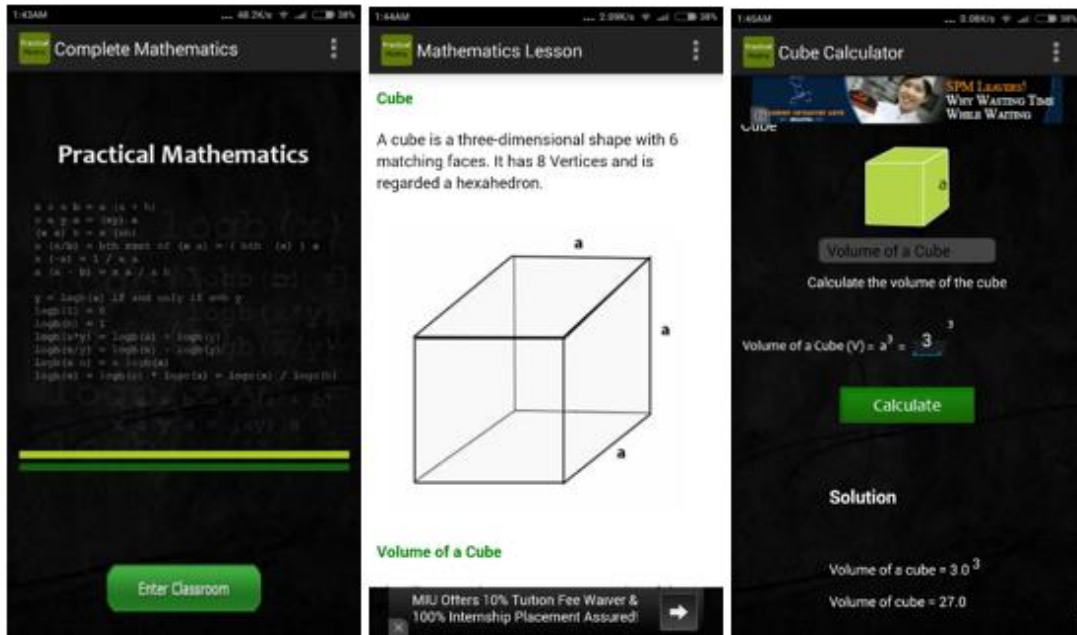
Figure 2.11: Screenshot of Complete Mathematics.

2.8 Critical Remarks

2.8.1 System Comparison

After reviewing the different kind of similar/ related system including the browser based and android based, summary are shown in table 2.3 and table 2.4.

Table 2.3: The criteria comparison of the reviewed systems (browser based) and proposed application.

Criteria	ICT Learning	One-school.net	MOE	Proposed Application
Free of Charge	No	Yes	Yes	Yes
Animation	Yes	No	Yes	Yes
User Interactivity	Yes	No	Yes	Yes
Malaysia's syllabus	No	Yes	Yes	Yes
Mobile device friendly	No	No	No	Yes
Work Without Internet Connectivity	No	No	No	Yes

*MOE refers to the courseware developed by Ministry of Education Malaysia

Table 2.4: The criteria comparison of the reviewed systems (android based) and proposed application.

Criteria	Solid Geometry	PMR Free	Guru App	Complete Mathematics	Proposed Application
Free of Charge	Yes	Yes*	Yes	Yes	Yes
Animation	No	No	No	No	Yes
User Friendly	Yes	No	Yes	Yes	Yes
Malaysia's syllabus	No	Yes	Yes	No	Yes
Mobile device friendly	Yes	Yes	Yes	Yes	Yes
Without Internet	Yes	No	No	Yes	Yes

2.8.2 Criteria Explanation

Table 2.5: The explanation of compared criteria.

Criteria	Elaboration
Free of Charge	The courseware are accessible with no cost required.
Animation	The use of animation to explain the lesson.
User Interactivity	The ability for user to interact with the system to control the content.
Malaysia's syllabus	The courseware are design according to Malaysia's syllabus defined by Ministry of Education Malaysia.
Mobile device friendly	Friendly to mobile devices.
Work Without Internet Connectivity	The application able to run with or without the internet connection.

Chapter 3 System Design

3.1 Requirements Determination

3.1.1 Functional Requirements

- Students can learn solid geometry through this application. (High Priority)
- Students are acknowledged with the focus of PT3 exam. (High Priority)
- Students able to view the formula related to solid geometry. (High Priority)
- Students can use this application to solve the calculation involving solid geometry. (High Priority)
- Students can select which topic they interested to learn without going through one by one. (High Priority)
- The application should be able to works without internet connection. (High Priority)
- Students can easily navigate to any part of the application. (High Priority)
- The application should include multimedia elements. (Medium Priority)
- Bilingual dictionary for the key terms. (Low Priority)

3.1.2 Non-functional Requirements

- Performance
  - The application need to respond in almost real time when the event is trigger by the learners. For example, the application must be able to show up the content immediately when learner click on the button.
- Extensibility
  - The application should allow future extension for more contents.
- Ease of use
  - The operation of application must not be complicated.
- Accurate
  - The content created must be accurate. For example the geometry calculator must return a correct answer.
- Accessibility
  - The application content should be always accessible without worrying about the availability of internet connection.

3.2 System Modules and Functionalities

CHAPTER 3 SYSTEM DESIGN

The application is created for Android phone and it consists of 6 different modules. The six modules and its respective functionalities are described in the table:

Table 3.1: Application Modules and its description.

Module	Description
Lesson	-Notes and other teaching material to let students understand about the chapter. -The lesson is divided into 4 sections: Basic Shapes, Solid Geometry I, Solid Geometry II, and Solis Geometry III. -In each chapter, the content is further divided into different topics for example area and volume. -Lesson will be presented in text, graphic, animation, video and audio. Text is the main element of this application because it does not require large storage space and much resources to run the application. -This module will acknowledge students about the focus area in PT3 examination.
Exercise	-This module let learners to practice with what he or she had learnt in the lesson module. -This module will prompt users to answer the question and verify the correctness of the answer. -Answer with solution will be provided. -This module will acknowledge students about the focus area in PT3 examination.
Formula	-A quick view to solid geometry related formula without the need of exploring the lesson module.
Glossary	-Overview of mathematical terms related to the topic in English and Malay.
Calculator	-A calculator to solve question related to solid geometry by inserting the measurement of the elements. -The calculator able to calculate the area and the volume of the selected solids. -This module may help students to check their answer.
Discussion Board	-This module required internet connection to works.

-This module provides a platform for students to discuss about subject matter.

-Students required to register and login in order to use this feature.

-Students can post a question or answer to the question.

Apart from the modules, a navigation bar will be included in home and sub-menu screen which help user to easily access to the whole application. The navigation bar will include an icon to link to each module.

CHAPTER 3 SYSTEM DESIGN

3.3 Use Case Diagram
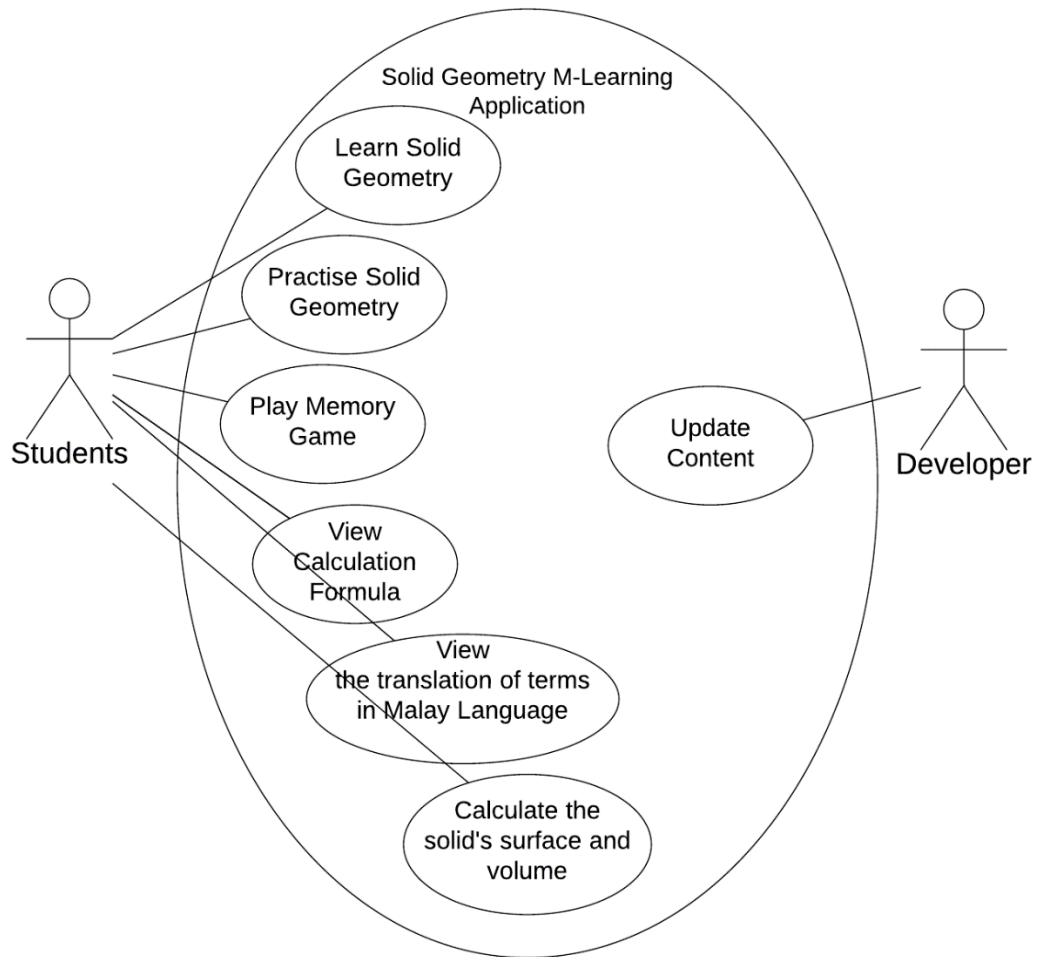
Figure 3.1: Use Case Diagram.

CHAPTER 3 SYSTEM DESIGN

3.4 Navigation Structure
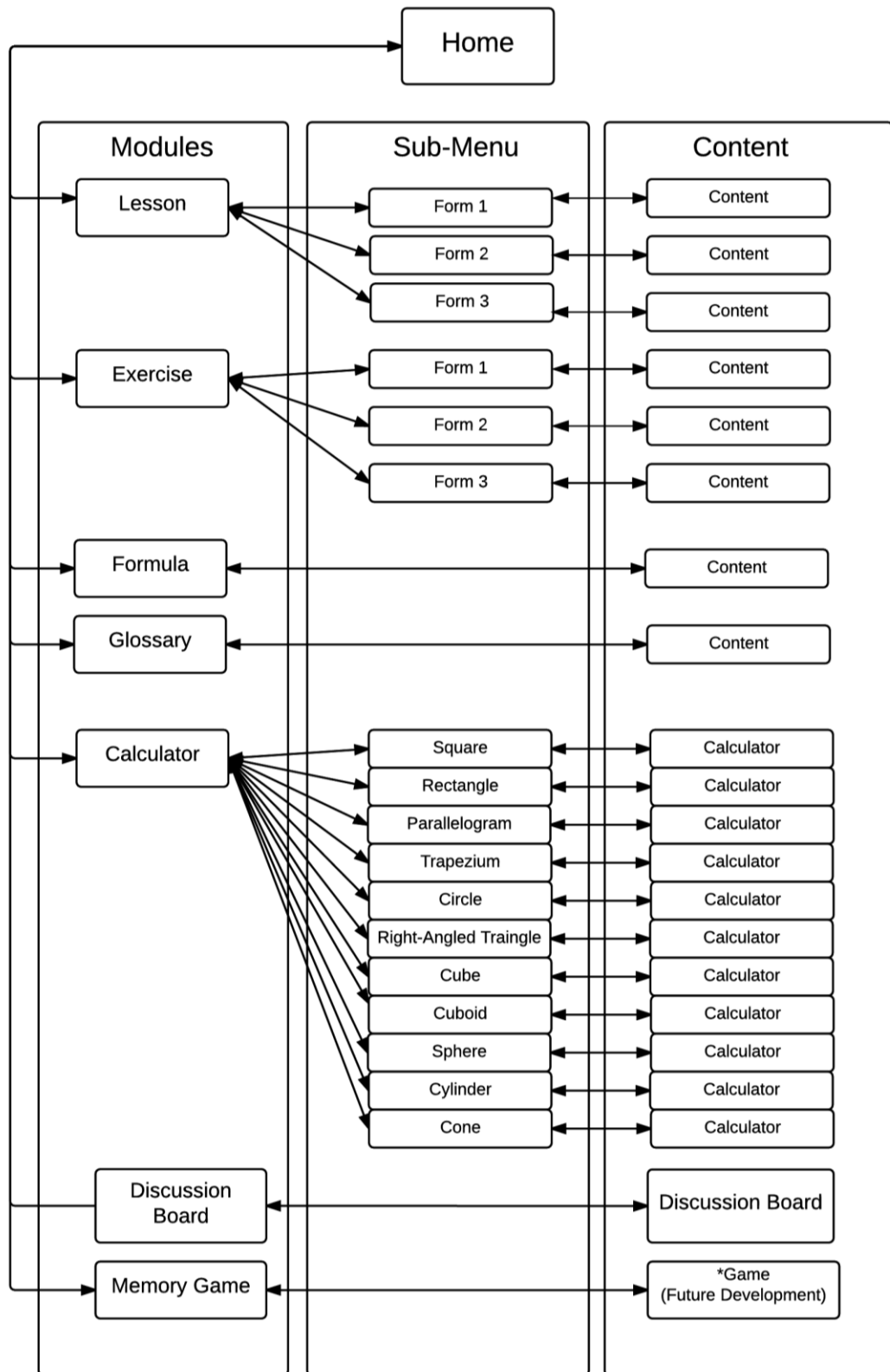
Figure 3.2: Navigation Structure.

CHAPTER 3 SYSTEM DESIGN

The application started with home screen and user can navigate to 6 different modules which are: lesson, exercise, formula, glossary, calculator and discussion board. After user selects the modules, sub-menu page will show up. By selecting the topic in sub-menu page, user will be redirected to the content. User allow to back to the previous screen from any screen. Figure below shows the summary of the navigation structure.
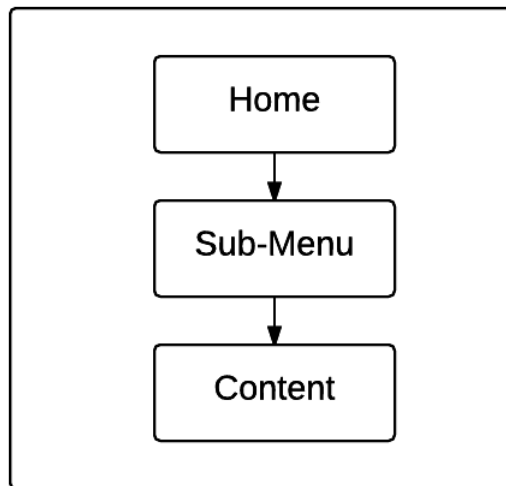
Figure 3.3: General hierarchical layout.

3.5 Multimedia Component

Before the development of application actually get started, the author creates and gather the required multimedia elements. Various type of application is used in this stage.

3.5.1 Process of editing picture

The picture obtained from the online source need to be resized before it can be used in mobile phone due to the screen size. A simple photo editing program is used for this purpose rather than Adobe Photoshop because Photoshop as a professional photo editing software it occupied a lot of computer resources during the process. Hence, the author selected MeiTuXiuXiu as the photo editing tool for this project.
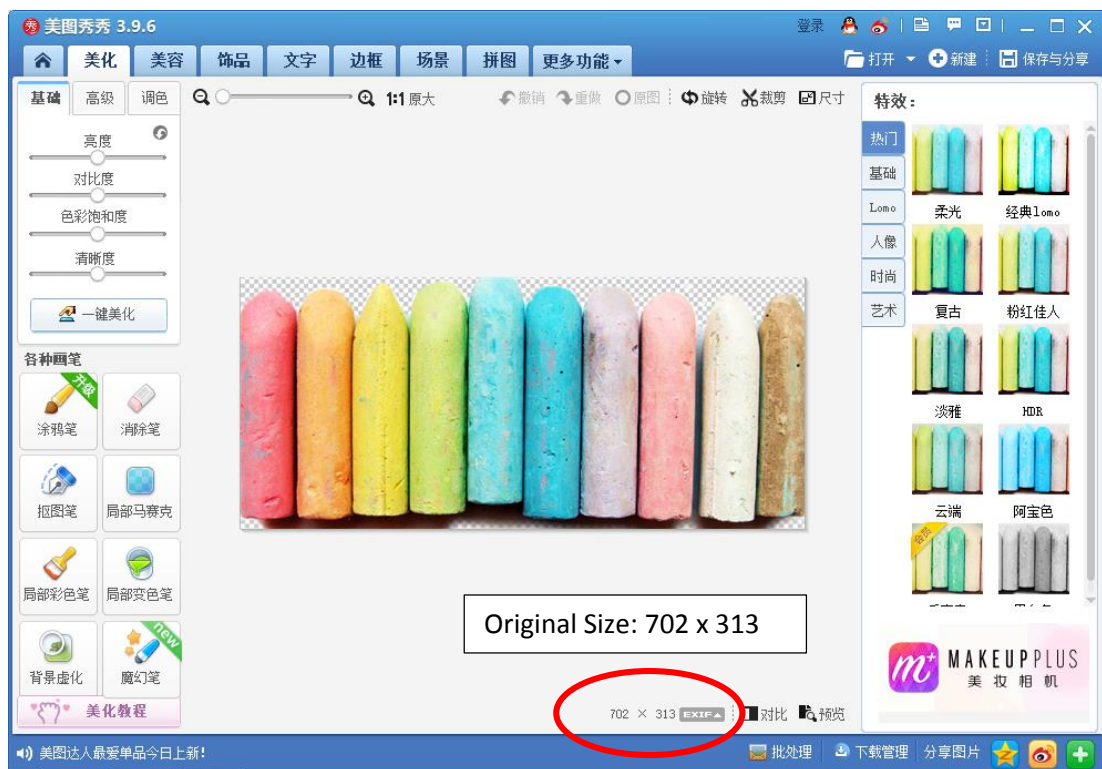
Figure 3.4 Opening a picture file in MeiTuXiuXiu.

As shown in Figure 5.1, the original size for this picture is 702px * 313px which is too large for mobile phone.
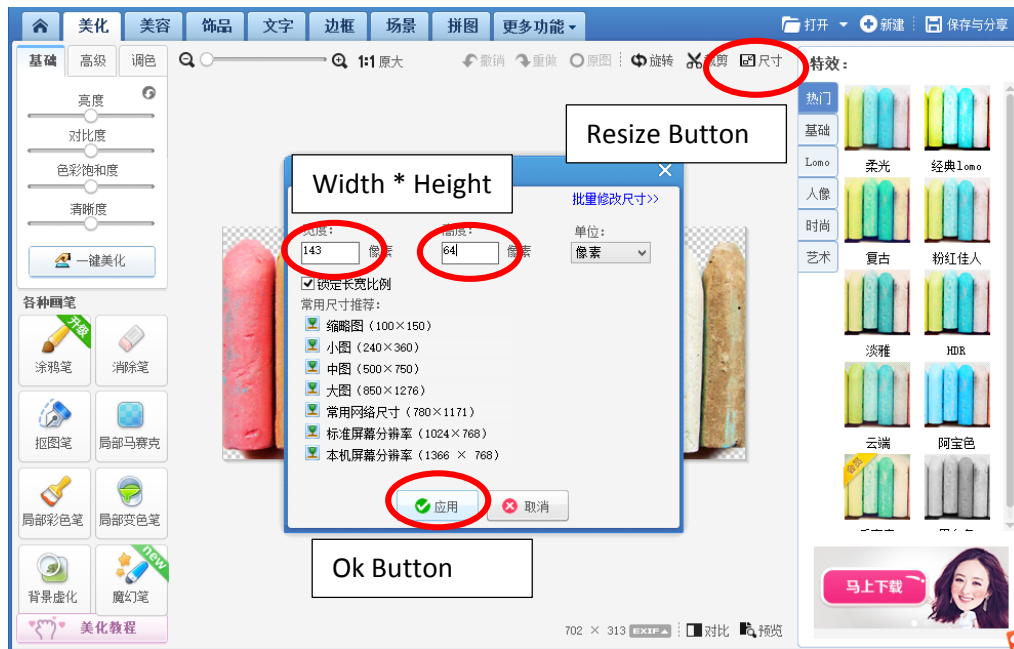
Figure 3.5 Process of editing picture.

First select the resize button, enter the desire width and height and finally clicked on the ok button. In this case, this photo is intended to be used as button, hence the width and height is resized to 143px * 64px.
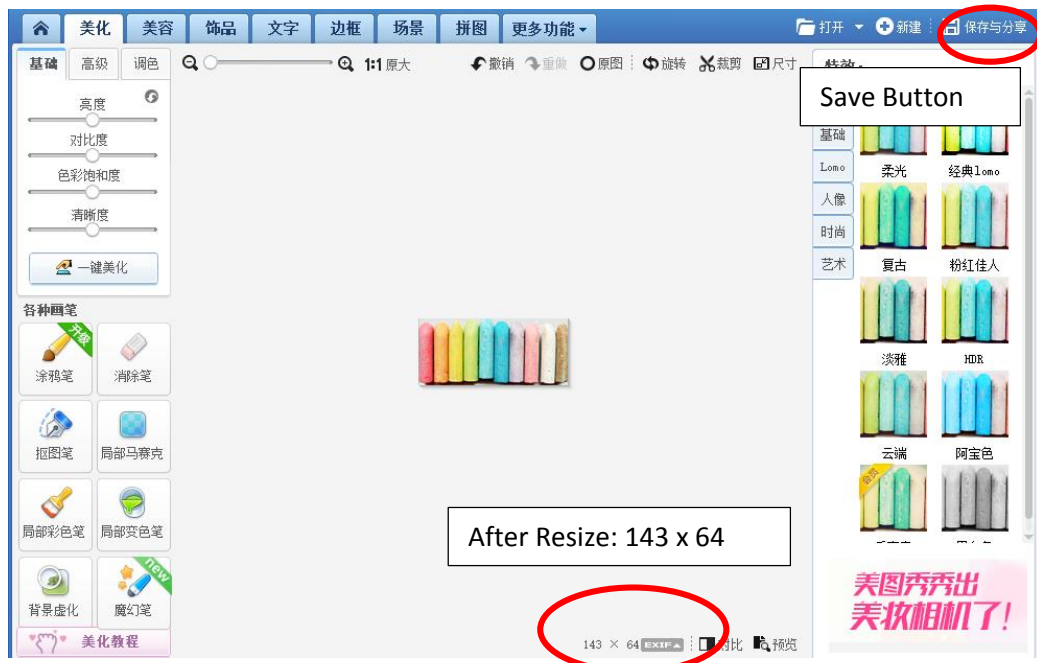
Figure 3.6 Completion of picture editing.

Click on the save button after resized. The editing process is completed.

3.5.2 Process of creating picture

This is a solid geometry mobile learning application by which it is compulsory to have the illustration of shape and solids. Microsoft Office PowerPoint is used to create the shapes. PowerPoint provide the shapes template and easy manipulation of the shapes.
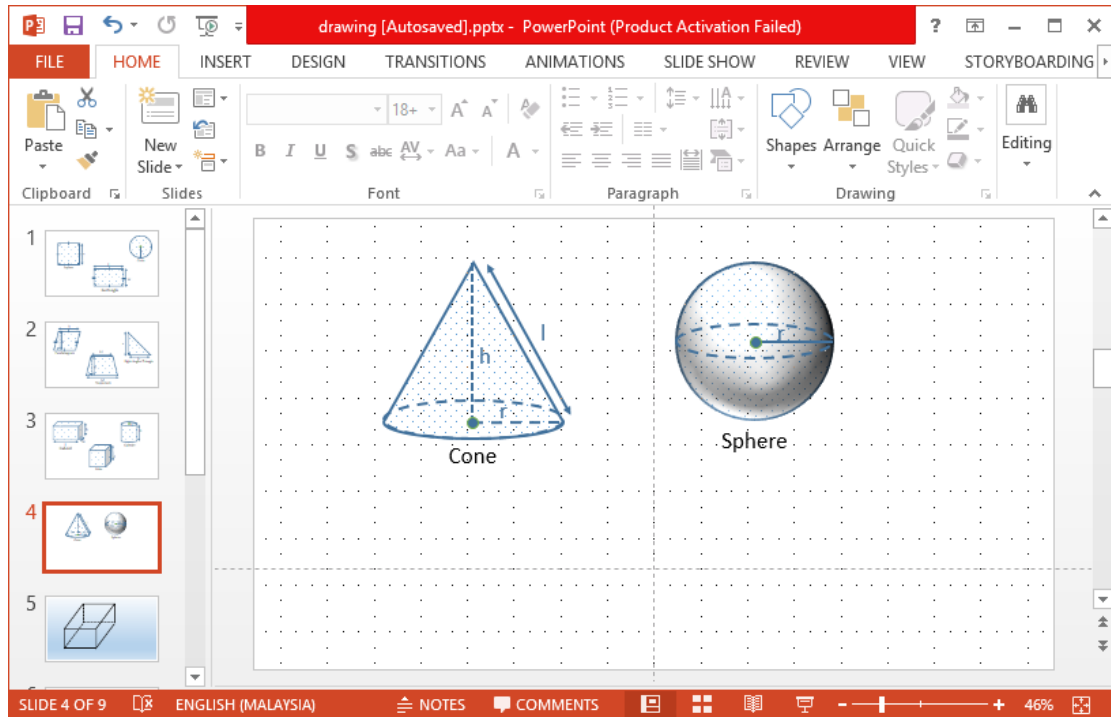
Figure 3.7: Sample picture created using PowerPoint.
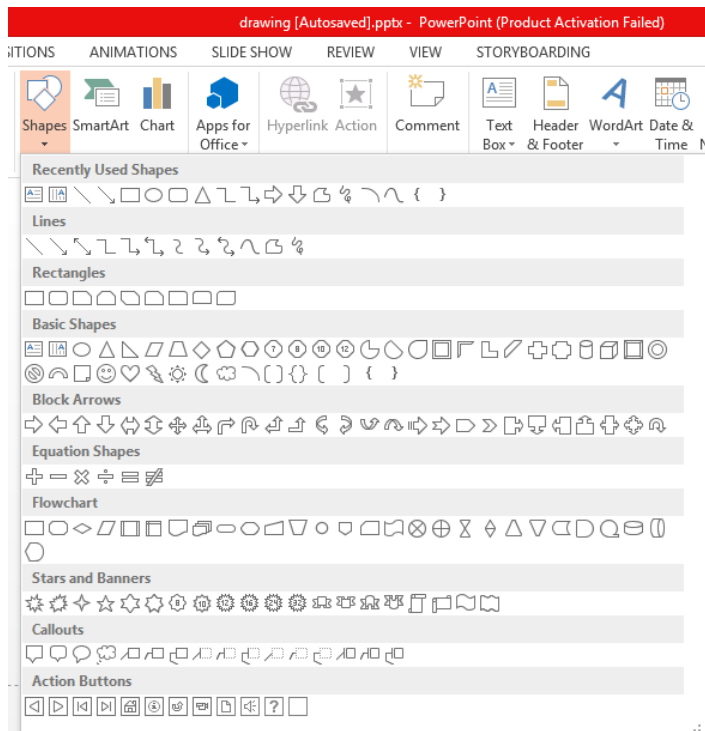
Figure 3.8: Shapes template provided in PowerPoint.
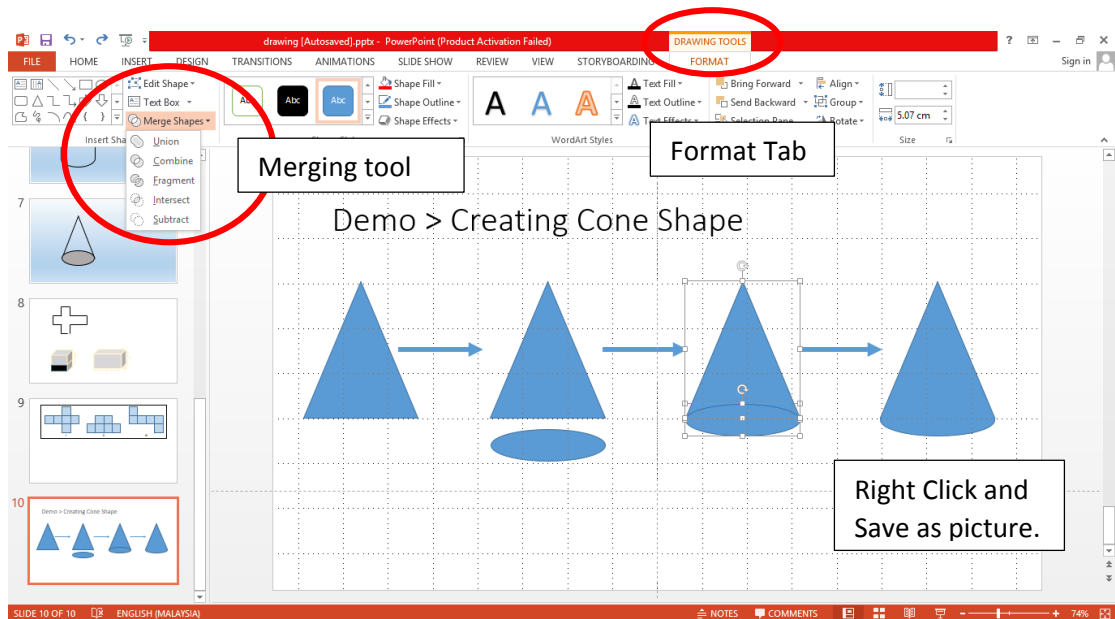
Figure 3.9: Creating a shape that is not provided in the template.

Figure 5.6 demonstrate the process of creating a Cone shape which is not provided in the in the toolbox. Cone shape can be created by merging (union) a triangle and an oval. Merging tool is fall under FORMAT > Merge Shapes. Right click on the cone shape select save as picture after merging.

3.5.3 Process of creating animation

The author uses frame animation in the application. Frame animation interchanged a series of static pictures which make the animation looks like it is moving. The author us gifmaker.me to generate the gif frame animation. Gifmaker.me is a website providing free tools to create, resize and split frame animation.
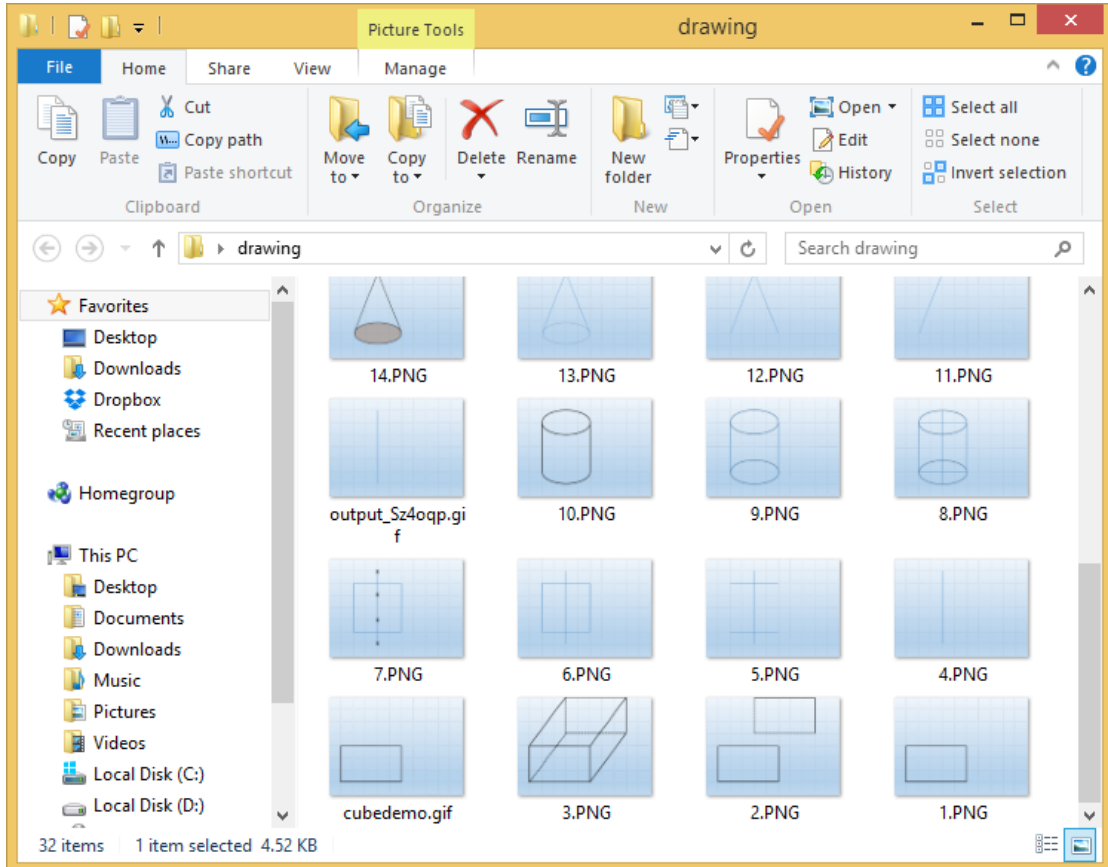
Figure 3.10: Source picture prepared to create animation.
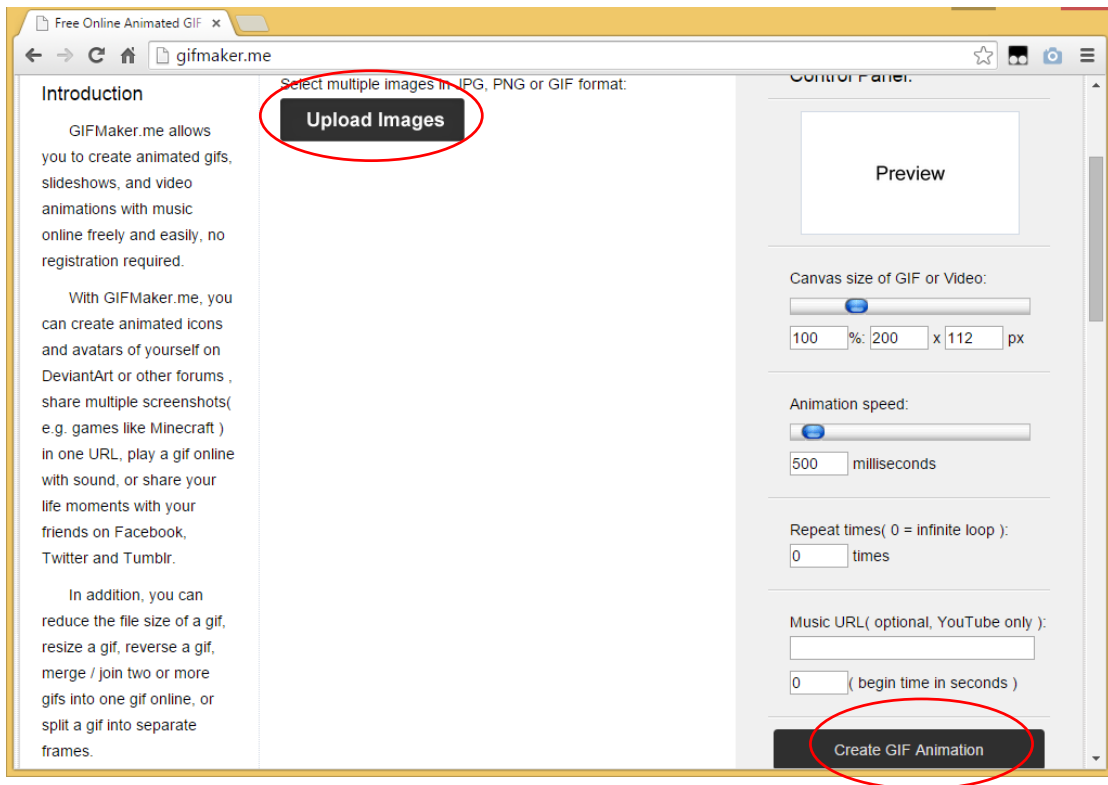
Figure 3.11: Screenshot of gifmaker.me.
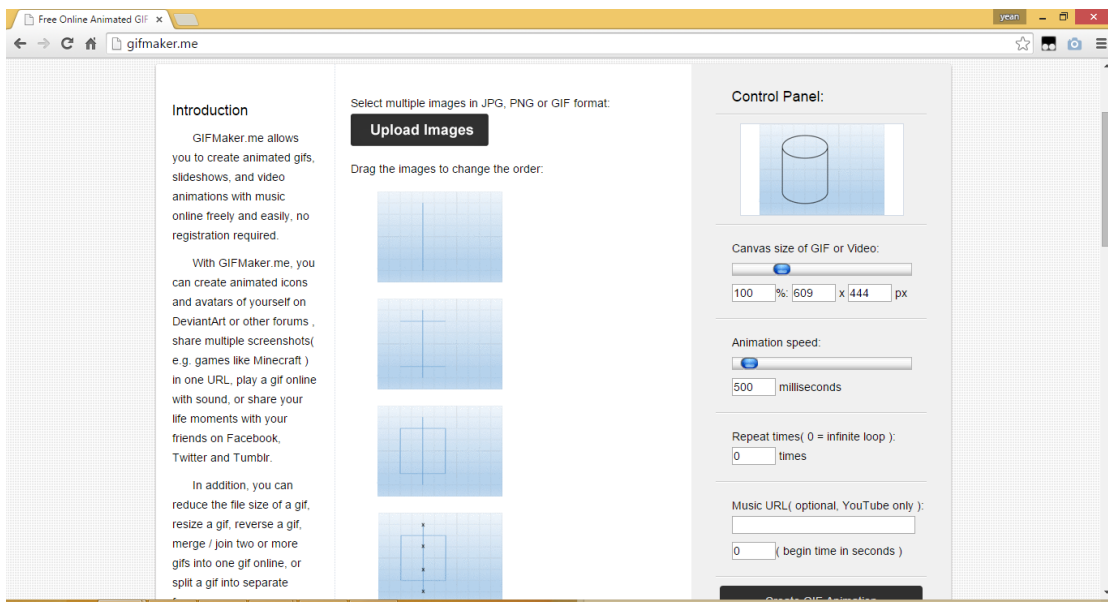
Figure 3.12: Creation of frame animation using gifmaker.me

Figure above shows the creation of animation file which illustrate the steps of drawing a cylinder size. The control panel provide the option of setting the file size, animation speed, repetition times and music.

CHAPTER 3 SYSTEM DESIGN

3.5.4 Text

The application content (Solid Geometry topics for Malaysia's lower secondary school students) is extracted from the books SUCCESS Mathematics (ISBN 978 983 47 1310 2) by the publisher Oxford Fajar. The content of the application is reliable as it is sourced from the author of textbooks.

3.6 Calculator Module

In calculator module, some effort has to be done in order to make sure the correctness of the calculation and also to ensure that the application able to prevent error to occur which might cause the application to crashed.

1. The input type is limited to number (decimal) only by restricting the input type to numberDecimal in XML file. Inputting non-numeric character is not allowed.

<p style="text-align:center;">android:inputType="numberDecimal"</p>

2. The answer field is disabled for input. This can be restricted in XML file.

<p style="text-align:center;">android:editable="false"</p>

3. All the required text field must not be blank. By default, if the required field is blank, when the user press on the calculate button the activity will be terminated and back to previous screen. If else condition is added in the JAVA code to prevent such error. If any of the input field is not filled, the application will toast a message to remind user to enter it else if all the field is entered, the application will proceed to the calculation.

> *If* any of the required field is blank
>
> Toast a message to remind user to enter
>
> *Else*
>
> Proceed to the calculation

4. The decimal point for the answer is limited to 2 decimal point.

CHAPTER 3 SYSTEM DESIGN

3.7 Android Version and Permission

This application required minimum version of android SDK 8 and it is developed to target android SDK version 18. It requires user permission to access to the internet and device vibration. The codes below must be added into the android manifest XML.

```
<uses-sdk
        android:minSdkVersion="8"
        android:targetSdkVersion="18" />


 <uses-permission android:name="android.permission.VIBRATE" />
 <uses-permission android:name="android.permission.INTERNET" />
```

CHAPTER 4 METHODOLOGY

Chapter 4 Methodology

4.1 ADDIE Model

This project will adopt the ADDIE Model as it development methodology. ADDIE Model or known as the Analysis Design Development Implementation Evaluation are one of the model under the Instructional System Design (ISD) which is commonly used in the development of training courseware. The Addie Model encompasses 5 framework activities which is Analysis, Design, Development, Implementation and Evaluation. The Evaluation process are categorise into 2 which includes formative evaluation and summative evaluation. Summative evaluation are carried out each stage of the ADDIE Model. (Instructionaldesigncentral.com, 2014).
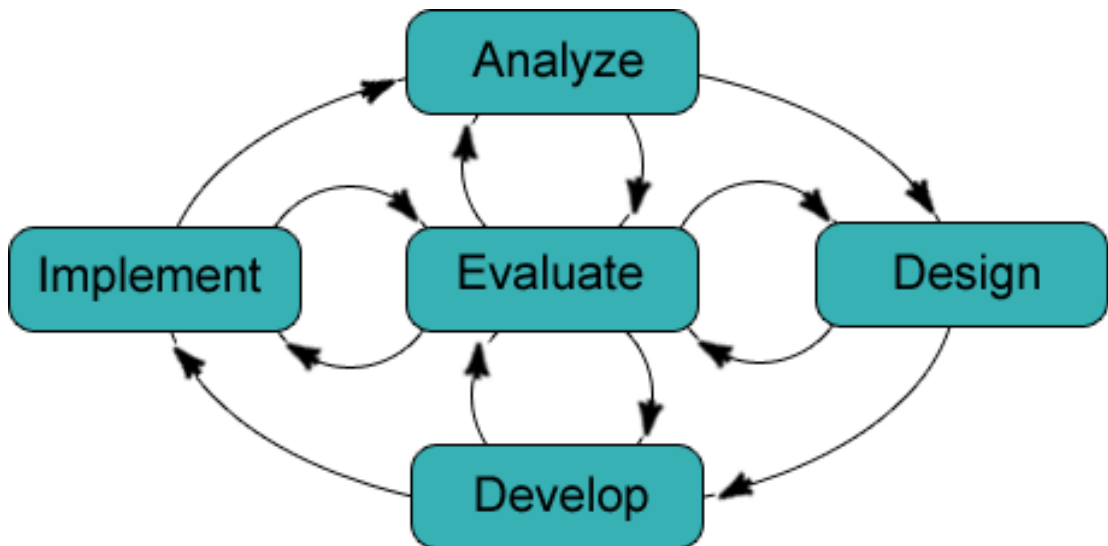
Figure 4.1: ADDIE Model.

CHAPTER 4 METHODOLOGY

ADDIE Model is selected because of its characteristics as below (Aris et al., 2014):

Table 4.1: Characteristics of ADDIE Model.

Characteristics	Elaboration
Systematic	The stages are clearly defined according to its logical order.
Systemic	The process view the system as a whole by considering all elements of the system which are critical for the success for example the environment, students and teachers.
Reliable	The steps are described in detail by which the author able to carried out the developing task according to the plan.
Iterative	The project cycle will be repeated until it comes out with a satisfied courseware that able to meet the objectives.
Empirical	The content of the courseware are collected from the syllabus eg. Textbook and reference book without the need of creating course structure through scientific research.

CHAPTER 4 METHODOLOGY

The table below describe tasks in each phases:

Table 4.2: ADDIE Phase's description.

Phases	Elaboration
Analysis	-Carry out pre-planning activities. -Identify the problem statement and motivation. -Identify target audience (secondary school students) and their needs. -Review the existing e-learning application. -Identify the courseware subject. -Identify the delivery method. -Identify the project outcome.
Design	-Design storyboard. -Design navigation structure. -Determine the courseware look and feel. -Determine the user-interface. -Determine the content. -Determine the modules included in the courseware.
Development	-Develop the courseware based on the outcomes of design phase. -Develop the content based on data collected. -Create multimedia content.
Implementation	-Invite target users to use the application. -Collect their feedback towards the application.
Evaluation	Formative Evaluation: -Carried out at every stage of ADDIE Model. Summative Evaluation: -Evaluating the effectiveness of the system based on students feedback. -Make necessary revisions if it is needed.

CHAPTER 4 METHODOLOGY

4.2 Technology Involved

4.2.1 Hardware Requirements

Computer

System type: Laptop

CPU: 2.3Ghz Intel Core i5 processor

RAM: 8GB 1333 MHz DDR3 RAM

Mobile Phone

Model : MI 3W

Android 4 Kitkat

Quad-core 2.3Ghz

RAM: 2GB

4.2.2 Software Requirements

Windows 8.1   -The operating system used for development.

Adobe Photoshop   -Graphical editing tool.

Eclipse   -Android development.

LucidChart.com   -Diagraming.

Mockingbot.com   -Prototyping.

Gifmaker.me   -Gif Animation.

4.2.3 Programming Language

Java, VB, ASP.net

4.2.4 Markup Language

XML, HTML, CSS

4.3 Gantt Chart

ID	Task Mode	Task Name	Duration	Start	Finish
1	✈	**Analysis**	**20 days**	**Thu 1/1/15**	**Wed 28/1/15**
2	✈	Analysis Tasks	15 days	Thu 1/1/15	Wed 21/1/15
3	✈	Formative Evaluation	2 days	Thu 22/1/15	Fri 23/1/15
4	✈	Revise if necessary	3 days	Mon 26/1/15	Wed 28/1/15
5	✈	**Design**	**20 days**	**Thu 29/1/15**	**Wed 25/2/15**
6	✈	Design Tasks	15 days	Thu 29/1/15	Wed 18/2/15
7	✈	Formative Evaluation	2 days	Thu 19/2/15	Fri 20/2/15
8	✈	Revise if necessary	3 days	Mon 23/2/15	Wed 25/2/15
9	✈	FYP1 Documentation Preparation	3 days	Thu 26/2/15	Mon 2/3/15
10	✈	FYP1 Documentation Submission	0 days	Tue 3/3/15	Tue 3/3/15
11	✈	FYP1 Presentation Preparation	5 days	Mon 6/4/15	Fri 10/4/15
12	✈	FYP1 Presentation	0 days	Fri 10/4/15	Fri 10/4/15
13	✈	**Development**	**100 days**	**Thu 26/2/15**	**Wed 15/7/15**
14	✈	Develop Calculator Module	15 days	Thu 26/2/15	Wed 18/3/15
15	✈	Develop Formula Module	10 days	Thu 19/3/15	Wed 1/4/15
16	✈	Develop Lesson Module	40 days	Thu 2/4/15	Wed 27/5/15
17	✈	Develop Exercise Module	40 days	Thu 2/4/15	Wed 27/5/15
18	✈	Develop PT3 watchout Module	10 days	Thu 28/5/15	Wed 10/6/15
19	✈	Develop Dictionary Module	10 days	Thu 11/6/15	Wed 24/6/15
20	✈	Formative Evaluation	7 days	Thu 25/6/15	Fri 3/7/15
21	✈	Revise if necessary	8 days	Mon 6/7/15	Wed 15/7/15
22	✈	**Implementation**	**9 days**	**Thu 16/7/15**	**Tue 28/7/15**
23	✈	Invite target audience to test the	3 days	Thu 16/7/15	Mon 20/7/15
24	✈	Collect Feedback	3 days	Thu 16/7/15	Mon 20/7/15
25	✈	Formative Evaluation	3 days	Tue 21/7/15	Thu 23/7/15
26	✈	Revise if necessary	3 days	Fri 24/7/15	Tue 28/7/15
27	✈	**Evaluation**	**10 days**	**Tue 28/7/15**	**Mon 10/8/15**
28	✈	Evaluate the course outcome	4 days	Wed 29/7/15	Mon 3/8/15
29	✈	Revise if necessary	5 days	Tue 4/8/15	Mon 10/8/15
30	✈	Release the application	0 days	Tue 11/8/15	Tue 11/8/15

Figure 4.2: Gantt Chart for the project.

CHAPTER 4 METHODOLOGY

4.4 Implementation Issue and Challenge

The major challenge author faced while developing this project is the selection of content. The author have to study carefully about the PT3 Mathematics syllabus before deciding to restrict the content to solid geometry chapters as the time constraint do not allow the author to include all the chapters. By comparing to the needs of digital representation by each topic and survey result from the target audience, finally the content is confirmed.

Furthermore, user interface design also one of the issue to the author. Without much knowledge in designing, the author have to design a comfortable and user friendly interface that suites the audience. Author have to figure out about how to make use of multimedia elements to further improve user learning experience.

Lastly, time is critical to the author. All the development stages and tasks needed to be planned carefully and reasonable to keep the progress on track especially when there are any trials and error during the application development.

Chapter 5 System Implementation

5.1 System Installation

There is 2 ways to install this application. Before installing to the mobile phone, user have to make sure that the smartphone operating system is android with the minimum sdk version 8 (or equivalent to Android 2.2 Froyo).

First method is the debug mode for the developers. Before the developers able to install the application through this method, the usb debugging setting in mobile phone must be enabled. After that, connect the mobile phone to computer using USB cable. Next, click on the run button in Eclipse IDE, it will automatically installed the application in the mobile phone.
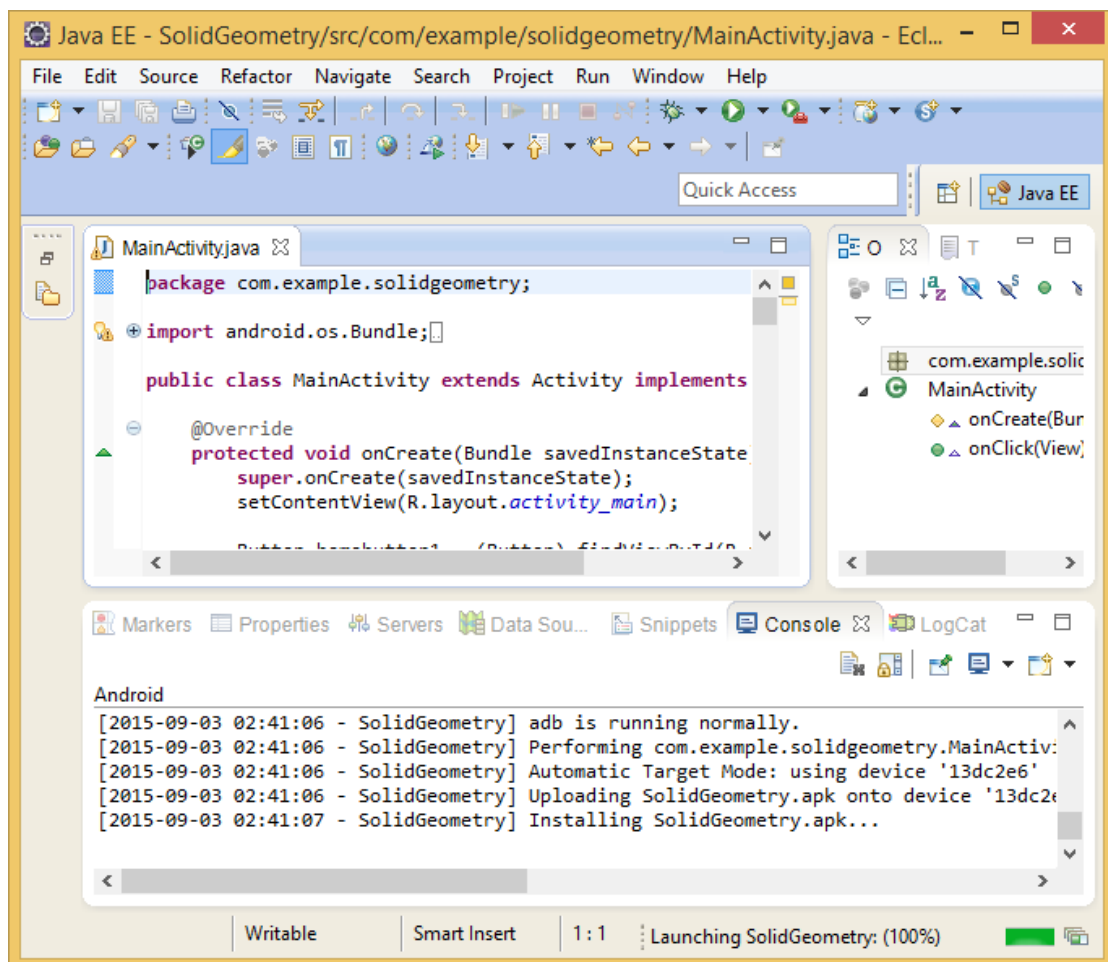
Figure 5.1: Installation of the application to mobile phone through debug mode.

The second method is to directly install the application to mobile phone through Application Package File (apk) installer. The apk file is located at the project folder

called bin, developer need to copy the installer to the user's mobile phone. User have to first enable the permission to install program which is not downloaded from the Google Play Store. The setting might be vary depends on the smartphone models.
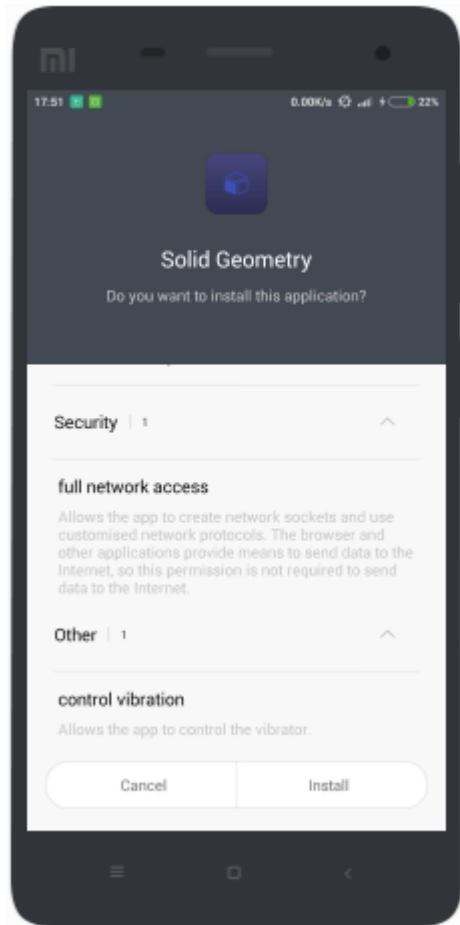
Figure 5.2: Installation of the application.

During the installation, user is informed that this application required the permission of full network access and control vibration. This application required the permission of full network access to connect to the internet while the permission of control vibration allows the application to vibrate the device.

5.2 Screenshot

CHAPTER 5 SYSTEM IMPLEMENTATION
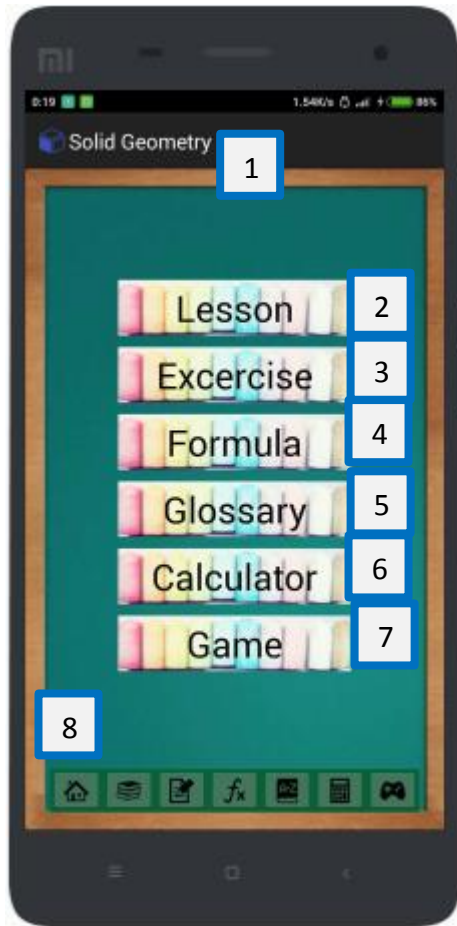
Figure 5.3: Main Menu Screen

Description of the activity:

This is the first screen to show when the user run this application. Main menu provides navigation to other modules.

1. The Activity Title (applicable to all activity in the application)
2. Button – Navigate to Lesson Activity
3. Button - Navigate to Self-Assessment Exercise Activity
4. Button – Navigate to Formula Activity
5. Button – Navigate to Glossary Activity
6. Button – Navigate to Calculator Activity
7. Button – Navigate to Game Activity
8. NavBar – Navigation bar to navigate between modules.
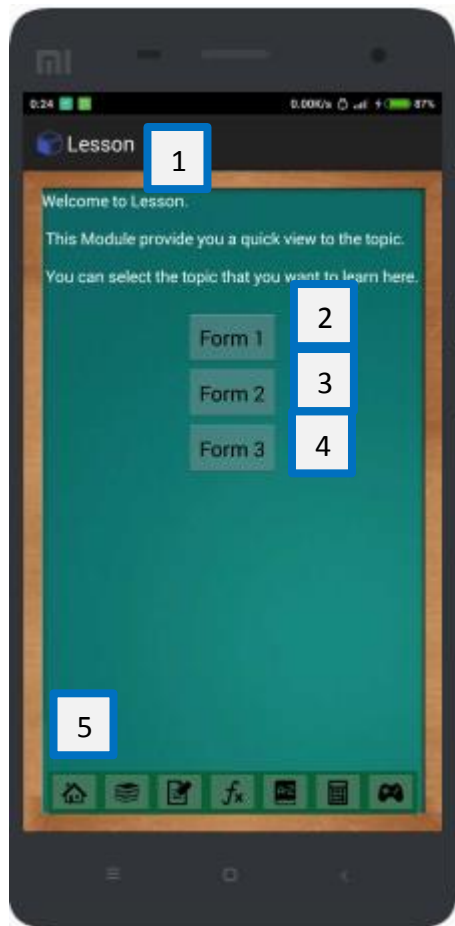
Figure 5.4: Lesson Sub-Menu Screen

Description of the activity:

This is the lesson sub-menu screen where user can select the topic they are interested to read.

1. The Activity Title (applicable to all activity in the application)
2. Button – Navigate to Form 1 lesson.
3. Button – Navigate to Form 2 lesson.
4. Button – Navigate to Form 3 lesson.
5. NavBar – Navigation bar to navigate between modules.
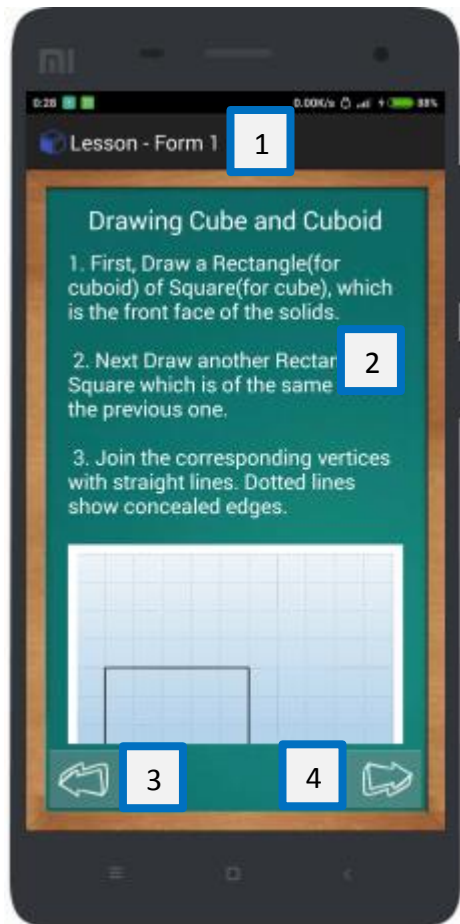
Figure 5.5: Lesson Content Screen

Description of the activity:

This is the lesson content screen. The lesson will be presented in text, graphic and animation.

1. The Activity Title (applicable to all activity in the application).
2. The Content.
3. Previous Button – Back to previous page.
4. Next Button – Go to next page.

Figure 5.6: End of Lesson Screen

Description of the activity:

This is the end of lesson screen. User can choose to study other lesson or go back to main menu.

1. The Activity Title (applicable to all activity in the application).
2. Button – Navigate to lesson-submenu page.
3. Button – Navigate to main menu.
4. Previous Button – Back to previous page.
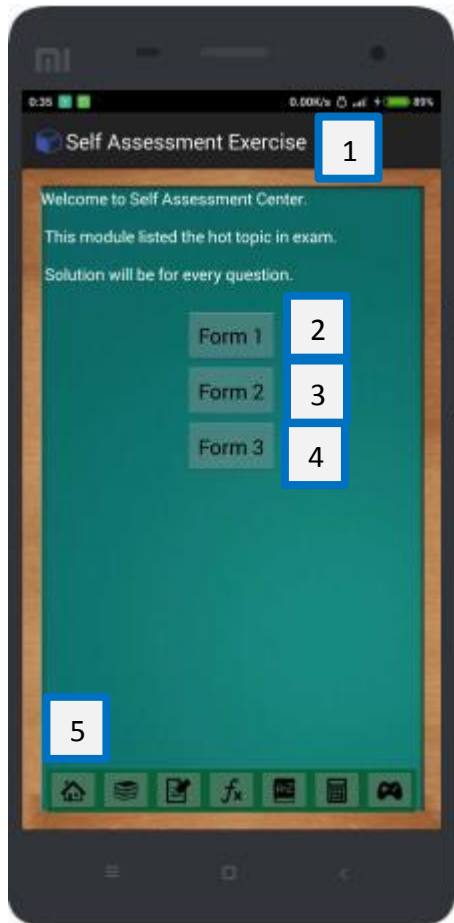
Figure 5.7: Self-Assessment Exercise Screen

Description of the activity:

This is the self-assessment exercise screen where user can select the topic they are interested to revise.

1. The Activity Title (applicable to all activity in the application)
2. Button – Navigate to Form 1 Self-Assessment Exercise.
3. Button – Navigate to Form 2 Self-Assessment Exercise.
4. Button – Navigate to Form 3 Self-Assessment Exercise.
5. NavBar – Navigation bar to navigate between modules.
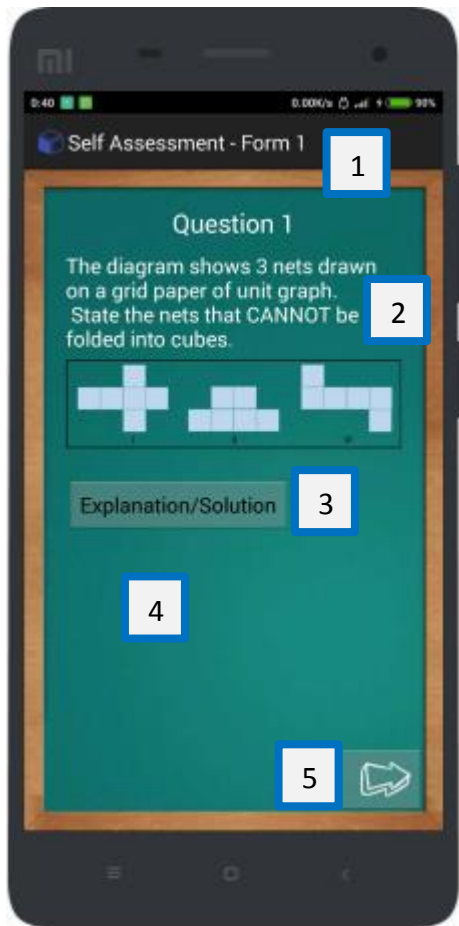
Figure 5.8: Self-Assessment Exercise Question Screen

Description of the activity:

This is the self-assessment question screen. The question is presented in text and graphic. User can click on the explanation/solution button to view the solution. When the button is clicked, it will turn visible and solution will be shown.

1. The Activity Title (applicable to all activity in the application).
2. The Question.
3. Button – Click to view the explanation or solution.
4. The solution will appear here after the button clicked.
5. Next Button – Go to next page.
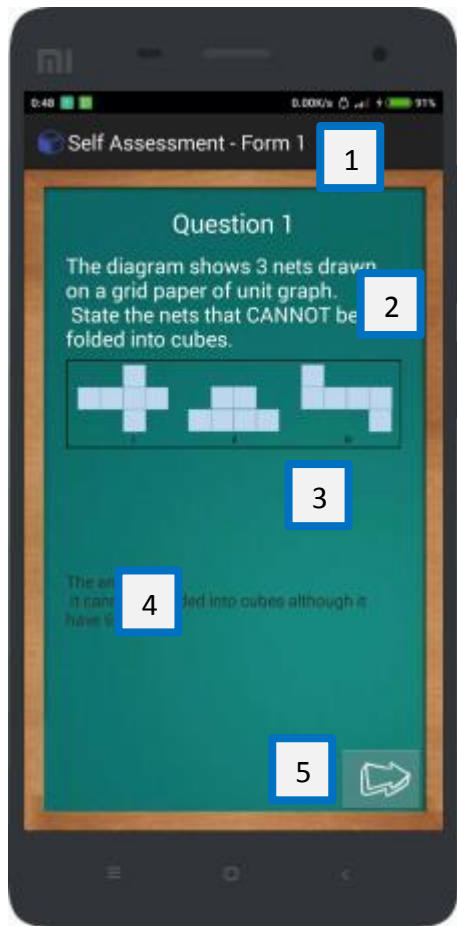
Figure 5.9: Self-Assessment Exercise Question Screen

Description of the activity:

This is the self-assessment question screen. The question is presented in text and graphic. User can click on the explanation/solution button to view the solution. When the button is clicked, it will turn visible and solution will be shown.

1. The activity title (applicable to all activity in the application).
2. The question.
3. Invisible Button – The explanation/solution button is now invisible after click.
4. The solution.
5. Next Button – Go to next page.

Figure 5.10: End of Self-Assessment Exercise Screen

Description of the activity:

This is the end of self-assessment exercise screen. User can choose to revise other topic or go back to main menu.

1. The Activity Title (applicable to all activity in the application).
2. Button – Navigate to self-assessment exercise submenu page.
3. Button – Navigate to main menu.
4. Previous Button – Back to previous page.
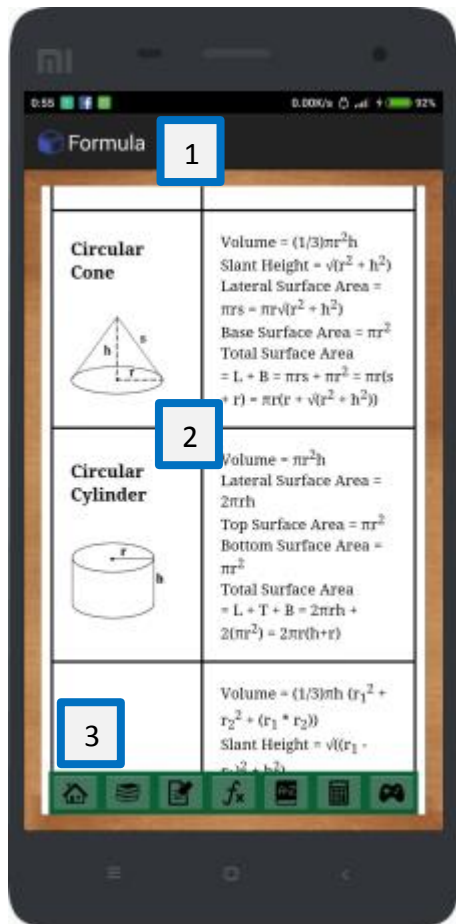
Figure 5.11 Formula Screen

Description of the activity:

This is the formula screen. This screen provide a summary of all the mathematical formula related to solid geometry.

1. The Activity Title (applicable to all activity in the application).
2. Content.
3. NavBar – Navigation bar to navigate between modules.

Figure 5.12 Glossary Screen

Description of the activity:

This is the Glossary screen. In this screen the bilingual keywords is shown. It is arranged in alphabetical order.

1. The Activity Title (applicable to all activity in the application).

2. Content.

3. NavBar – Navigation bar to navigate between modules.
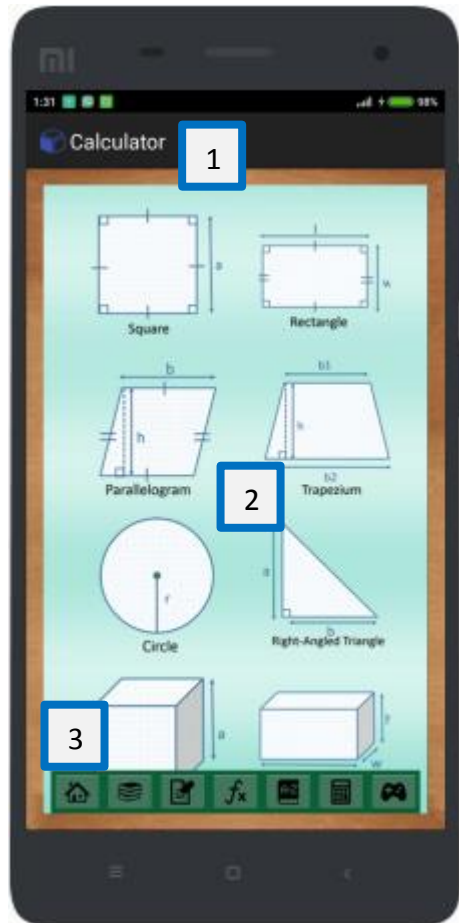
Figure 5.13 Calculator Menu Screen

Description of the activity:

This is the calculator menu screen. User choose a shape or solids that they want to calculate.

1. The Activity Title (applicable to all activity in the application).
2. Image Button – click to enter the calculator screen for different shapes.
3. NavBar – Navigation bar to navigate between modules.
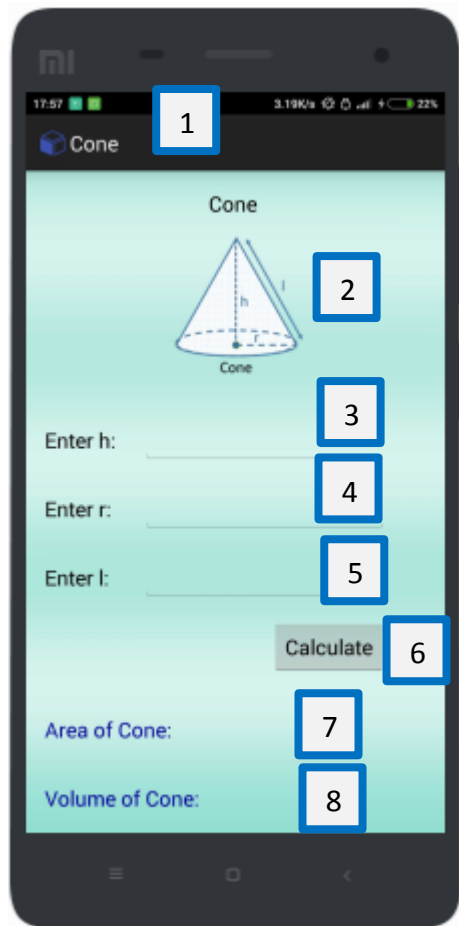
Figure 5.14 Cone Calculator Screen

Description of the activity:

This is the calculator screen for cone where other shapes have the same interface and function as well. In these screens, user enter the number into provided field to calculate the Area and-(or) Volume.

1. The Activity Title (applicable to all activity in the application).
2. The picture of the shape with label of the variable.
3. EditText (text field) for user to enter the variable.
4. EditText (text file) to display the answer.
5. EditText (text file) to display the answer.
6. Button – Click to calculate.
7. Display the calculated answer.
8. Display the calculated answer.
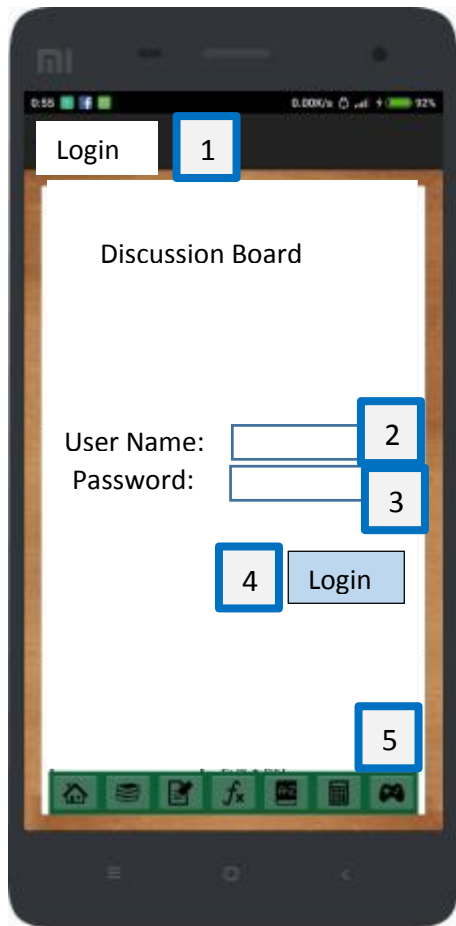
Figure 5.15 Discussion Board Login Screen

Description of the activity:

This is the discussion board login screen.

1. The Activity Title (applicable to all activity in the application).

2. EditText (text field) for user to enter the user name.

3. EditText (text field) for user to enter the password.

4. Button – Click to login.

5. NavBar – Navigation bar to navigate between modules.
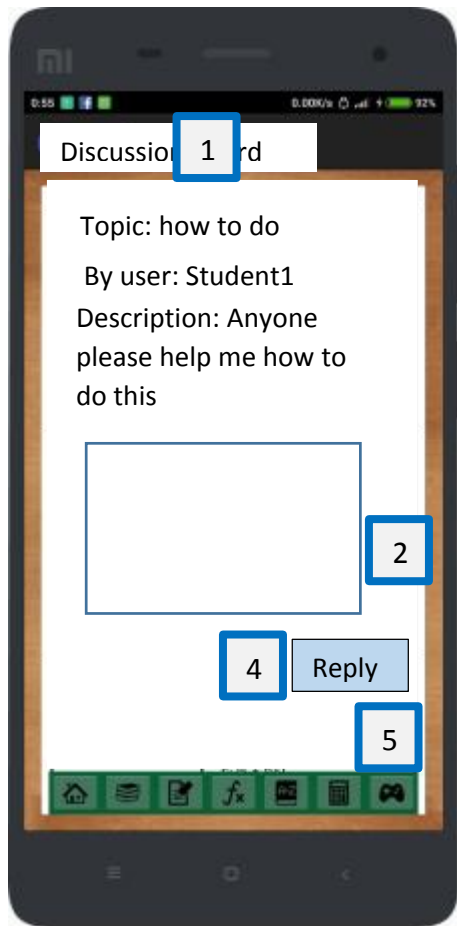
Figure 5.16 Discussion Board Discussion Screen

Description of the activity:

This is the discussion board discussion screen.

1. The Activity Title (applicable to all activity in the application).
2. EditText (text field) for user to reply to the topic.
3. Button – Click to reply.
4. NavBar – Navigation bar to navigate between modules.
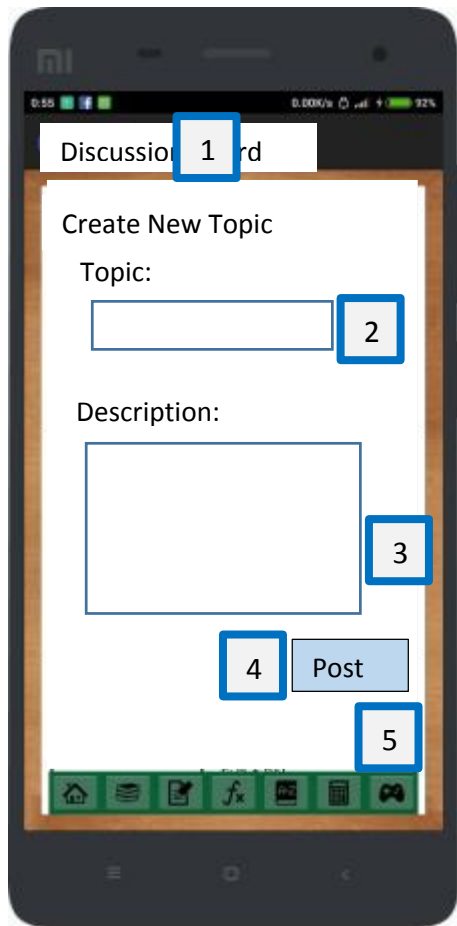
Figure 5.17 Discussion Board create new discussion Screen

Description of the activity:

This is the discussion board create new discussion screen.

1. The Activity Title (applicable to all activity in the application).
2. EditText (text field) for user to enter the topic.
3. EditText (text field) for user to enter the description.
4. Button – Click to post.
5. NavBar – Navigation bar to navigate between modules.

CHAPTER 6 TESTING

Chapter 6 Testing

6.1 Navigation Bar

Table 6.1: Navigation bar testing result.

No	Event	Expected Result	Result
1.	User click on the first (home) button.	Navigate to Main Menu Screen	Pass
2.	User click on the second (books) button.	Navigate to Lesson module	Pass
3.	User click on the third (paper & pen) button.	Navigate to Exercise module	Pass
4.	User click on the forth (formula) button	Navigate to Formula module	Pass
5.	User click on the fifth (dictionary) button.	Navigate to Glossary module	Pass
6.	User click on the sixth (calculator) button.	Navigate to Calculator module	Pass
7.	User click on the seventh (game) button.	Navigate to Game Module	Pass
8.	User click on any of the button except the one that user already in	Navigate to that particular module and the phone will vibrate to indicate that user have move to another module	Pass
9.	User click on the button where the user already in that module	Toast a message telling user that he or she already at that module	Pass

CHAPTER 6 TESTING

6.2 Menu Screen

Table 6.2: Menu screen testing result.

No	Event	Expected Result	Result
1.	User click on the "Lesson" button.	Navigate to Main Menu module.	Pass
2.	User click on the "Exercise" button.	Navigate to Exercise module.	Pass
3.	User click on the "Formula" button.	Navigate to Formula module.	Pass
4.	User click on the "Glossary" button.	Navigate to Glossary module.	Pass
5.	User click on the "Calculator" button.	Navigate to Calculator module.	Pass
6.	User click on the Game button.	Navigate to Game module.	Pass
7.	User click on the "Exit" button.	Toast a message to ask user to click again to exit the program. When user click twice, user will quit the application.	Pass

CHAPTER 6 TESTING

6.3 Lesson and Excercise Module

6.3.1 Lesson Sub Menu Screen

Table 6.3: Lesson sub menu testing result.

No	Event	Expected Result	Result
1.	User click on the "Form1" button.	Navigate to Form 1 lesson content screen.	Pass
2.	User click on the "Form2" button.	Navigate to Form 2 lesson content screen.	Pass
3.	User click on the "Form3" button.	Navigate to Form 3 lesson content screen.	Pass

6.3.2 Lesson Content Screen

Table 6.4: Lesson content testing result.

No	Event	Expected Result	Result
1.	User click on the "Next" button.	Navigate to next screen.	Pass
2.	User click on the "Previous" button.	Navigate to previous screen.	Pass

6.3.3 End of Lesson Screen

Table 6.5: End of lesson testing result.

No	Event	Expected Result	Result
1.	User click on the "Other Lesson" button.	Navigate to lesson sub menu screen.	Pass
2.	User click on the "Main Menu" button.	Navigate to main menu screen.	Pass

6.3.4 Self-Assessment Sub Menu Screen

Table 6.6: Self-assessment sub menu testing result.

No	Event	Expected Result	Result
1.	User click on the "Form1" button.	Navigate to Form 1 self-assessment content screen.	Pass
2.	User click on the "Form2" button.	Navigate to Form 2 self-assessment content screen.	Pass
3.	User click on the "Form3" button.	Navigate to Form 3 self-assessment content screen.	Pass

6.3.5 Self-Assessment Content Screen

Table 6.7: Self-assessment content testing result.

No	Event	Expected Result	Result
1.	User click on the "Next" button.	Navigate to next screen.	Pass
2.	User click on the "Previous" button.	Navigate to previous screen.	Pass

6.3.6 End of Self-Assessment Screen

Table 6.8: End of self-assessment testing result.

No	Event	Expected Result	Result
1.	User click on the "Other Question" button.	Navigate to self-assessment sub menu screen.	Pass
2.	User click on the "Main Menu" button.	Navigate to main menu screen.	Pass

6.4 Calculator Module

Table 6.9: Calculator sub menu testing result.

No	Event	Expected Result	Result
1.	User click on the "Square" picture	Navigate to square calculation screen.	Pass
2.	User click on the "Rectangle" picture	Navigate to rectangle calculation screen.	Pass
3.	User click on the "Parallelogram" picture	Navigate to parallelogram calculation screen.	Pass
4.	User click on the "Trapezium" picture	Navigate to trapezium calculation screen.	Pass
5.	User click on the "Circle" picture	Navigate to circle calculation screen.	Pass
6.	User click on the "Right-Angled Triangle" picture	Navigate to right-angled triangle calculation screen.	Pass
7.	User click on the "Cube" picture	Navigate to cube calculation screen.	Pass
8.	User click on the "Cuboid" picture	Navigate to cuboid calculation screen.	Pass
9.	User click on the "Cylinder" picture	Navigate to cylinder calculation screen.	Pass
10.	User click on the "Sphere" picture	Navigate to sphere calculation screen.	Pass
11.	User click on the "Cone" picture	Navigate to cone calculation screen.	Pass

CHAPTER 6 TESTING

6.4.1 Square Calculation Screen

Table 6.10: square calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of Square" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input a = 5	Output area = 25.0	Pass

6.4.2 Rectangle Calculation Screen

Table 6.11: Rectangle calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass

| 3. | User click on the calculate button after entered all the required field with numeric character. | Display the calculated answer in "Area of Rectangle" field. Device's soft keypad hides. | Pass |
| 4. | Calculation correctness test: input l=7, w=8 | Output area = 56.0 | Pass |

6.4.3 Parallelogram Calculation Screen

Table 6.12: Parallelogram calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of Parallelogram" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input h=5, b=7	Output area = 35.0	Pass

6.4.4 Trapezium Calculation Screen

Table 6.13: Trapezium calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of Trapezium" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input h=6, b1=3,b2=3	Output area = 81.0	Pass

6.4.5 Circle Calculation Screen

Table 6.14: Circle calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass

| 3. | User click on the calculate button after entered all the required field with numeric character. | Display the calculated answer in "Area of Circle" field. Device's soft keypad hides. | Pass |
| 4. | Calculation correctness test: input r =8.8 | Output area = 243.38 | Pass |

6.4.6 Triangle Calculation Screen

Table 6.15: Triangle calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of "Triangle" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input a=7, b =4.5	Output area = 15.75	Pass

6.4.7 Cube Calculation Screen

Table 6.16: Cube calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of Cube" field and "Volume of Cube" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input a=3.9	Output area = 36.0, volume=216.0	Pass

6.4.8 Cuboid Calculation Screen

Table 6.17: Cuboid calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass

| 3. | User click on the calculate button after entered all the required field with numeric character. | Display the calculated answer in "Area of Cuboid" field and "Volume of Cuboid" field. Device's soft keypad hides. | Pass |
| 4. | Calculation correctness test: input h=6, w=4, l=4.5 | Output area = 138.0, volume=108.0 | Pass |

6.4.9 Cylinder Calculation Screen

Table 6.18: Cylinder calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of Cylinder" field and "Volume of Cylinder" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input h=6, r=5	Output area = 345.62, volume= 471.3	Pass

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6.4.10 Sphere Calculation Screen

Table 6.19: Sphere calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass
3.	User click on the calculate button after entered all the required field with numeric character.	Display the calculated answer in "Area of Sphere" field and "Volume of Sphere" field. Device's soft keypad hides.	Pass
4.	Calculation correctness test: input r=8.8	Output area = 973.27, volume=2854.91	Pass

6.4.11 Cone Calculation Screen

Table 6.20: Cone calculation screen testing result.

No	Event	Expected Result	Result
1.	User attempt enter non-numeric character in the available text field.	Nothing happen, user can't enter non-numeric character.	Pass
2.	User click on the calculate button without entering numeric character to all the available text field.	Toast a message to remind user that the field is required. Device's soft keypad hides.	Pass

| 3. | User click on the calculate button after entered all the required field with numeric character. | Display the calculated answer in "Area of Cone" field and "Volume of Cone" field. Device's soft keypad hides. | Pass |
| 4. | Calculation correctness test: input h=3.8,r=4.8,l=2 | Output area = 102.55, volume=91.7 | Pass |

6.5 Discussion Board Module

Table 6.21: Discussion Board testing result.

No	Event	Expected Result	Result
1.	User register account.	Account Registered.	Pass
2.	User enter correct password when login.	Login to the discussion board.	Pass
3.	User enter wrong password when login.	Prompt user to enter again.	Pass
4.	User post and reply discussion topic.	Content posted.	Pass

6.6 Vibration

Table 6.22: Vibration testing result.

No	Event	Expected Result	Result
1.	User switches between application modules.	Vibrating the device.	Pass

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6.7 Internet Access

Table 6.23: Internet access testing result.

No	Event	Expected Result	Result
1.	User attempt to access to internet content.	Internet content shown.	Pass
2.	User does not have internet connection.	Display error message to the user.	Pass

Chapter 7 Conclusion

In conclusion, the deliverable of this project will be an Android mobile application which allow students to learn and practice solid geometry related chapters. Students able to access the free mathematics learning courseware that is fully compatible with the subject circumstance. It is believe that through this application, the mathematics learning process will become more interesting hence will motivate students to have active learning instead of passive learning. This application is hopping to become an alternative revision tools for Malaysia's lower secondary school students when they are preparing for PT3 examination.

The six modules included in this application helps student to understand the concept, increase problem solving capabilities, learn from error, alert with the type of questions in PT3 examination as well as a useful tool from them to verify the correctness of answer for the question which they attempted. With this application, students allowed to learn solid geometry any place and anywhere without much hassle as long as the devices are along with them.

7.1 Future Development

This application is design to cater with future development and improvement. One of the module which will be added in future is Game Module. Memory game helps student to have better recognition of the shapes. Below are some of the characteristic of this planned module.

-There will be 3 different level in for the game which suitable for students from different level.

-There will be 16-20 cards in each game.

-Each card will display either a photo of the solids, a photo of the object, name of the solids or other properties that is relevant to the topic.

-Students has to recognize the properties and match the correct cards together.

Bibliography

Aris, B., Hura Ahmad, M., Bilal Ali, M., Harun, J. and Boon Shiong, K. (2014). Learning "Goal Programming" Using an Interactive Multimedia Courseware: Design Factors and Students' Preferences. *Learning "Goal Programming" Using an Interactive Multimedia Courseware: Design Factors and Students' Preferences*, [online] 3(1), pp.85-95. Available at: http://pdf.aminer.org/000/240/340/navigation_design_for_interactive_multimedia .pdf [Accessed 22 Nov. 2014].

Craig, R. (1996). *The ASTD training and development handbook*. New York: McGraw-Hill.

Faghih, B. and Reza Azadehfar, M. (2013). User Interface Design for E-Learning Software. *User Interface Design for E-Learning Software*, [online] 3(3). Available at: http://arxiv.org/ftp/arxiv/papers/1401/1401.6365.pdf [Accessed 17 Nov. 2014].

Hill, S. (2014). *Android 5 vs. iOS 8 vs. Windows Phone 8.1: Which smartphone OS is best?*. [online] Digital Trends. Available at: http://www.digitaltrends.com/mobile/best-smartphone-os/ [Accessed 1 Feb. 2015].

Instructionaldesigncentral.com, (2014). *Instructional Design Models and Methods | Instructional Design Central*. [online] Available at: http://www.instructionaldesigncentral.com/htm/IDC_instructionaldesignmodels.h tm [Accessed 24 Nov. 2014].

Ismail, I., Bokhare, S., Azizan, S. and Azman, N. (2014). Teaching via Mobile Phone: a Case Study on Malaysian Teachers' Technology Acceptance and Readiness. [online] 10(1). Available at: http://www.thejeo.com/Archives/Volume10Number1/Ismail.pdf [Accessed 17 Feb. 2015].

Lazaris, L. (2009). *Designing Websites for Kids: Trends and Best Practices - Smashing Magazine*. [online] Smashing Magazine. Available at: http://www.smashingmagazine.com/2009/11/27/designing-websites-for-kids-trends-and-best-practices [Accessed 23 Nov. 2014].

Mahamad, S., Ibrahim, M. and Mohd Taib, S. (2010). M-LEARNING: A NEW PARADIGM OF LEARNING MATHEMATICS IN MALAYSIA. *International journal of computer science & information Technology (IJCSIT)*, [online] 2(4). Available at: http://airccse.org/journal/jcsit/0810ijcsit07.pdf [Accessed 14 Feb. 2015].

Nielsen, J. (1993). *Usability engineering*. Boston: Academic Press.

Pi. (1998). [film] UK: Darren Aronofsky.

Soong, S. (2012). *TEACHING OF MATHEMATICS AND SCIENCE IN ENGLISH IN MALAYSIA*. 1st ed. [ebook] Kuala Lumpur: The Chinese Chamber of Commerce & Industry of Kuala Lumpur & Selangor. Available at: http://www.chinesechamber.org.my/html/themes/chinesechamber/images/content /bulletin342/Teaching%20of%20Mathematics%20and%20Science%20in%20En glish%20in%20Malayisa.pdf [Accessed 19 Nov. 2014].

Stead, G. (2005). Moving mobile into the mainstream. *MLearn*, [online] 2005. Available at: http://www.mlearn.org.za/CD/papers/Stead.pdf [Accessed 1 Feb. 2015].

Tofel, K. (2010). *Android Sales Overtake iPhone in the U.S.*. [online] Gigaom.com. Available at: https://gigaom.com/2010/08/02/android-sales-overtake-iphone-in-the-u-s/ [Accessed 1 Feb. 2015].

Yadav, S. (2014). *Global Smartphone OS Market Q3 2014: Android Dominates With 84% Share*. [online] Dazeinfo. Available at: http://dazeinfo.com/2014/11/04/global-smartphone-os-market-share-q3-2014-android-ios-windows-report/ [Accessed 1 Jan. 2015].