COMPUTER AIDED INSTRUCTIONS (CAI) MATHEMATICS USING LEARNER CENTERED APPROACH

BY

TENG SZE LE

A REPORT

SUBMITTED TO

Universiti Tunku Abdul Rahman

in partial fulfillment of the requirements

for the degree of

BACHELOR OF INFORMATION SYSTEMS (HONS) BUSINESS INFORMATION SYSTEMS

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DECLARATION OF ORIGINALITY

I declare that this report entitled "COMPUTER AIDED INSTRUCTIONS (CAI) MATHEMATICS USING LEARNER CENTERED APPROACH" 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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ABSTRACT

This project is about an interactive multimedia application act as a resolve solution for the target audience which is primary school student. The author found the data to prove that primary school student is facing the difficulty to learn the Mathematics due to the problem statements which is will be discussed in the following chapter and Mathematics Learning application is the multimedia learning tool for student to solve their encounter problems. In order to complete this project, ADDIE methodology is used as common method for the whole project from the beginning to the end. The selected topics and content in Mathematics will be transform into multimedia way to serve as educational purpose for the primary school student. All the content and development of the project is based on the data analysis from the respondent and the content is standardized for all. The approach used in the learning process is learner centered approach. The author also discusses about the multimedia in many aspects to create a better understanding of multimedia and develop the project based on the good understanding of literature review on similar applications. Task of the project is planned well in order all the process can proceed on track and produce a productivity project in the given period.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1 INTRODUCTION

1.1 Introduction

Mathematics is considered as one part of the human research for understanding. It is all around the human, in everything human do and daily life including mobile devices, money, art, engineering, and even sports. The needs of mathematics arose based on the wants of society. The more complex a society, the more complex the mathematical needs. Nowadays, mathematics is an important subject in every stage of the studying. Implement the multimedia technologies in mathematics has stimulated more than one sense at a time which are more attention-getting and attention-holding. Studies showed that student who learned history using multimedia had made long lasting connection with the materials. It is the same theory when apply in mathematics subject. The combination of animated graphics, sound, video, text and virtual reality under a system with supporting strategy and concrete interactive design can lead to better content comprehension.

1.2 Background

In the era of high technology, the usage of Mathematics of Multimedia learning has been increasing due to the explosion in the use of digital media in education such as schools, campus and classroom which equipped with computers, Internet of Things (IoT) and digital technology to provide a better learning environment.

The importance of a mathematics concept or skill is difficult to communicate in relation to other concepts or skills in a curriculum sequence because students lack a sense of mathematics as a whole. Mathematics educator should provide an understandable justification of why a mathematics concept or skill is necessary and meaningful in their daily life. By combining the multimedia and the Mathematics context, the multimedia images of current applications of mathematics give students a dynamic impression of Mathematics as multimedia material provides a rich visual and auditory context to them. The application of students' problem-solving skills in a multimedia context is only a small step away from the transfer of the skills to everyday life. (Michael E. Hale, 2004)

According to Balarabe Yushau, a proper use of various technologies especially computers in the teaching and learning of mathematics has the potential of helping learners to develop their creativity. By using the technologies, learners and users can extend their mathematics skill which is to calculate or reproduce problems under the atmosphere. Besides, the atmosphere also lead the learners able to investigate, analyse and interpret problems themselves.

Furthermore, learners can deal with mathematical problems by using the experimental approach with computers, which is can lead to counter examples, pattern finding, examples and conjecture. In long term, if use the technologies frequently and effectively, computational aids can help to improve intellectual ability of learners and thus mathematical achievement while fostering the requisite creativity not found in the traditional approach. (Yushau, Mji, & Wessels, 2005)

All the benefits bring to Mathematics leaners through the power of multimedia technology had risen up the usage of multimedia Mathematics learning as learners and educators start to realize the importance of the combination of multimedia and the learning context bring a very powerful effect to their learning process.

1.3 Problem Statement and Motivation
1.3.1 Shorter attention span of kids
- Primary pupils' attention span is about 25 minutes to 30 minutes. While mathematics lesson of primary school always conducts more than 30 minutes. Pupils will be lost attention after 30 minutes if the lesson brings bored materials.
- Mathematics learning in traditional teaching way instead of vivid form, pupils will absorb lesser and lesser after 30 minutes because kids have shorter attention span compare to adult and they only interested in vivid things.

1.3.2 Lack of interest and motivation in learning mathematics
- Mathematics can be very hard for primary pupils even if it is a very simple subject as pupils do not have any interested. Pupils face a lot of problems in learning mathematics such as memorize the theory and techniques of mathematics but cannot answer the question if the question's pattern has changed. It is because pupils totally do not try to understand the theory and techniques. Question can be very easy to solve if pupils understand the theory and techniques.
- Besides, lack of motivation from teachers and parents may cause the lack of interest in mathematics learning. Good motivation can push pupils to another stage of learning mathematics.

1.3.3 Ineffective teaching method

- As mentioned as problem 1, primary pupils cannot absorb much after attention span of 30 minutes due to the traditional teaching method. Ineffective teaching method may cause the pupils face problem in learning mathematics. To point it out, teacher just read the theory and techniques from text book and give solution of question without explanation. Pupils who are slow learner may have a lot of doubts or cannot understand how the solution solves the question.
- Some teachers may be rushing to finish the syllabus in the given period causes the lesson conduct too fast also consider as ineffective teaching method as pupils who are slow learner not able to absorb all the lesson in short period.

1.3.4 Lack of effective teaching tools

- Elder mathematics teacher may not able to fully utilize the effectiveness of multimedia teaching tools. To point it out, teacher may just use the power point to show the learning material. This causes the elder teacher unable to bring the effective and interesting mathematics lesson to primary pupils.
- Effective teaching tools make the mathematics in vivid form so that the pupils have motivation to understand and willing to learn through the interesting teaching tools. Sometimes, picture is more than words can describe.

1.4 Objectives

Based on the problem that are faced in Problem and Solution in Chapter 1 Project Background. There are there objectives that should be achieved:

1) To study and investigate the usage of computer aided instructions for KSSR mathematics curriculum.
2) To design and develop an interactive multimedia application for KSSR mathematics context using learner centred approach.
3) To study and evaluate the effectiveness of implementing this application as a supplementary material to aid in the understanding of learners in mathematics context.

1.5 Scope
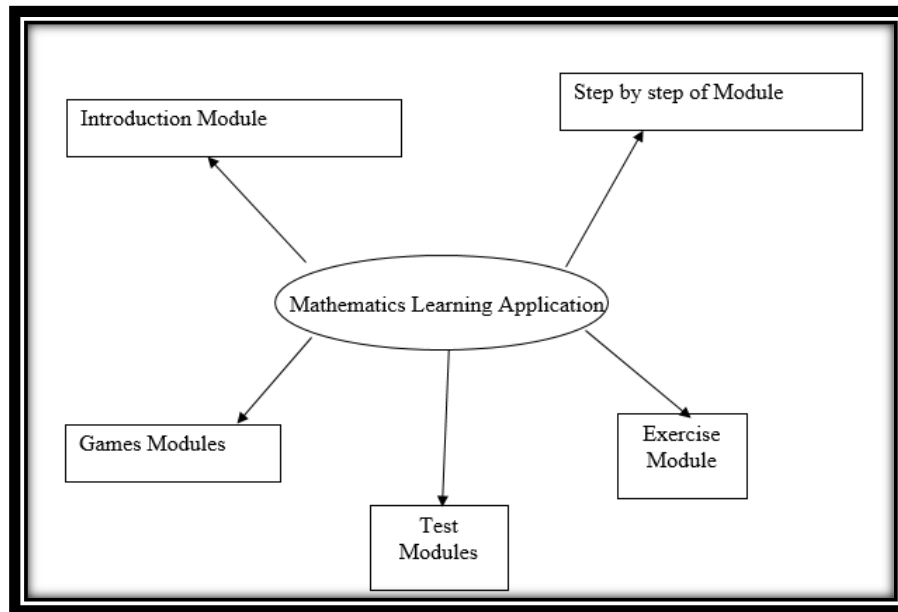
Figure 1.5 Project Scope

1.5.1 Introduction Module

A basic module to introduce the mathematical word problems to primary pupils in a very simple way to let user get familiar with what is mathematical word problems, what is the importance in our daily life and how to apply it in our daily life. This module allow user to gain a better understanding of mathematical word problems through the integration of audio, text, graphic and animation. By introducing this module, user will long last their memory of mathematical word problems and feel confidence in the subject.

1.5.2 Step by Step Module

This module seems similar to lesson or learning type. A few instructions will guide the user how to analyse different type of the question, how to solve the question in effectiveness way and theory is given during this learning module. After this, user will get basic knowledge of the mathematical word problems.

1.5.3 Exercise Module

Different type and pattern of mathematical word problems questions are provided in this module according to the different level. Practice makes perfect, a lot of exercise will make user get familiar with the pattern of mathematical word problems question.

1.5.4 Test Module

It is similar to MOCK test. This module modifies the reality exam of primary school in mathematics subject and provide few set of MOCK tests to let user answer like in exam mode. It is to examine the output of using this application.

1.5.5 Games Module

Few type of interactive games is provided in this module to let user interact with the mathematical word problems as well as to learn something more through the game in relax mode. User will gain more interesting and tend to learn more for mathematical word problems.

1.6 Contribution and Significance

An interactive learning application will design and develop by the author based on the problem stated and the needs of primary pupil due to the problem facing by primary pupils as well as to solve their encounter problems in learning mathematics. The application integrates all the multimedia elements such as animation, audio, graphics and text which are can grab the attention of user to learn more while using this application. To point it out, the project combines 3D graphics, interesting sound clips and animation to create stunningly beautiful presentations and animations in the multimedia application interface.

Furthermore, the author plans to implement the multimedia technology in this learning application to act as a powerful supplementary material for primary pupils in learning process of mathematics. Besides, the application combines all the process of learning mathematics in one so that user can learn all the material just according to their attention span and may continue later. By using this application, user can save the unnecessary cost to learn mathematics and it is convenience to use it at everywhere.

1.7 Target Audience

Primary pupil is targeted by the author as primary school is where the pupils start to know and learn the foundation of mathematics. Foundation of mathematics have to strengthen as it is basic and have to continue to further explore hard and useful mathematics. Mathematics not only apply in exam question but in daily life also. The author tends to use mathematic problems solving train the pupil to familiar with daily life mathematic instead. Mathematics multimedia application will be very interesting and user friendly to grab the attention of pupils to study and practice more in home.

CHAPTER 2 LITERATURE REVIEW

2.1 Multimedia

There are many ways to define multimedia. According to Fenrich, multimedia is the exciting combination of computer software and hardware that allows user to integrate all the multimedia element which are audio, animation, video, graphics and text resources to develop effective presentations on an affordable desktop computer (Fenrich, 1997), while according to Phillips, multimedia is characterized by the presence of text, pictures, sound, animation and video, some or all of which are organized into some coherent program (Phillips, 1997).

From the statements above, the common characteristics from these definition is multimedia includes audio, animation, video, text and graphics in a unified way and the content may be structured and perform in various ways.

Furthermore, multimedia systems must be computer controlled, information must be represented digitally, and the interface to the final user may permit interactivity as well as all multimedia components are integrated.
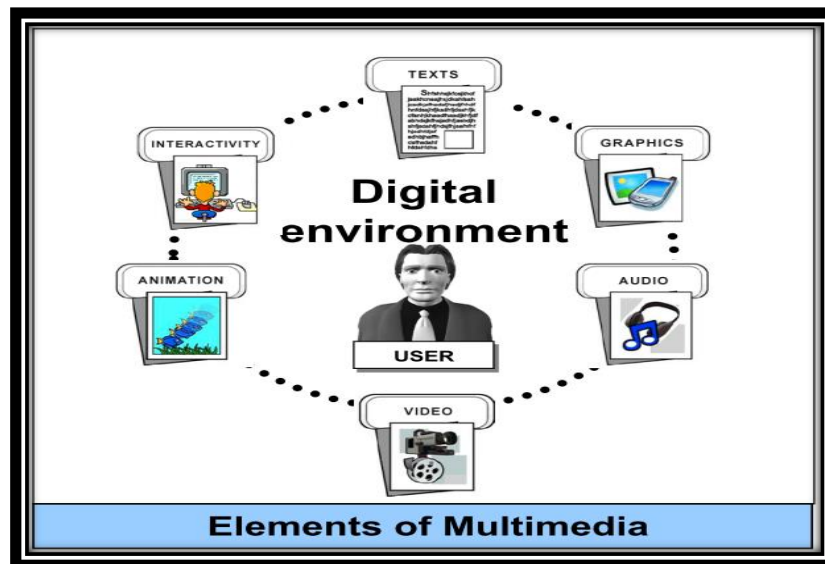
Figure 2.1 The elements of multimedia

2.1.1 Linear Multimedia

There are few types of multimedia and linear multimedia is one of the types of it which is designed to be presented in a straight pathway, a sequential manner, and it goes on a logical flow from a beginning point to a conclusion. The purposes of linear multimedia is used to display content and presentation with not much distraction or interaction with audience. Linear multimedia defined as passive multimedia also because of its nature. The main goals of linear multimedia are just to entertain, to transmit knowledge, and to make audience familiar on a certain topic and content without any form of diversion. For instance, a movie combine audio, graphics and animations but user has no influence over the arrangement of events.

Due to lack of extra features such as control the flow of the multimedia presentation, more options to choose, change the pace or click the icons make it has no interactivity which causes the user cannot take more benefits from linear multimedia.

2.1.2 Interactive Multimedia

The Encyclopedia Britannica defines Interactive Multimedia as any computer-delivered electronic system that allows the user to control, combine, and manipulate different types of media, such as audio, animation, video, graphics and text. Those hardware such as computer, memory storage, telephone, television, digital (binary) data and other information technologies are integrated for interactive multimedia purpose. Interactive multimedia provides some common application such as the video games, travel guides, electronic encyclopaedias and training programs. Besides, it shifts the role of users from observer to participant and it can consider as the next generation of electronic information systems (The Editors of Encyclopædia Britannica, 1998).

In other words, interactive multimedia is a contrast of linear multimedia that allows user to associate with the substance according to what they require and need, which means it is a two-way correspondence.

Furthermore, interactive multimedia has been defined as synonym with another frequently used term which is hypermedia (Randall Bass, n.d.). Hypermedia is a kind of hypermedia in multimedia version. By choosing how to navigate among the chunks of text by many electronic links in the hypertext, the reader can control the sequence of reading. While hypermedia is a collection of multimedia materials with various type of sequences and arrangements. Hypertext and hypermedia only exist in a computer-based environment which is referred as electronic concepts because in this environment, the materials only can be linked and organized in

multiple ways simultaneously, searched, sorted and navigated in hundreds of possible combinations by different users (Randall Bass, n.d.).

2.2 Interactive Multimedia

2.2.1 Benefits

From the definition of interactive multimedia above, we can know that it has the ability to deliver huge amounts of materials in various ways such as deliver it in a digital integrated environment that allows users to control the reading and viewing experience. All these characteristics of interactive multimedia and virtues actually bring a lot of advantages for learner or user in such an educational environment.

As mentioned above, multimedia programs have the ability and capacity to deliver huge amount of computerized material to education. For instance, schools, university, libraries, and learning centre where text books and study materials are hard to find and update, while multimedia can act as a powerful tool and efficient source for acquiring learning resources. Besides, multimedia can provide educational institutions access to other kinds of inaccessible materials, such as hard to find historical films, illustrations from difficult to obtain periodicals, rare sound recordings of famous speeches and others (Randall Bass, n.d.).

Moreover, interactive multimedia applications provides a wide variety of powerful sorting, linking, searching and annotating activities which enables the user to control materials. Each of these activities can be made to reinforce and inculcate various intellectual skills, in addition to satisfying certain cognitive needs for quality learning, such as the ability to follow through links at the immediate moment when curiosity is aroused, and the ability to view different forms of the same information side-by-side (Randall Bass, n.d.).

According to Mike Mannion, interactivity can also be used to support synchronous and asynchronous communications between a learner and an educator or between groups of learners through the agency of electronic mail, bulletin boards and electronic conferencing (Mike Mannion, 2014). This communications can encourage the learner able to consider alternative interpretations and helping to clarify any misunderstandings instead of just apply new knowledge to be presented in the discussion. This process of dialogue can promote reconceptualization as well as encourages reflective thinking and lead to a deeper understanding of the material being learned (Mayes, 1995).

Students using multimedia are seeing, reading, hearing, and actively manipulating materials. According to Menn (Menn, D., 1993), human remember only about 10% of what they read, remember 20%, what they hear, 30% of what they can see visuals related to what they are hearing, 50%, if they watch someone do something while explaining it and almost 90% of what they do the job themselves. In other words, interactive multimedia in properly developing and properly implementing could revolutionize education (JR Garcia, 1994).

Although revolutionize may sound a bit optimistic, but interactive multimedia act as a promising medium for extending, reinforcing and supplementing like what does the classroom conduct with print materials, lectures and classroom discussions (Randall Bass, n.d.).

2.2.2 Limitations
As mentioned in the benefits part, interactive multimedia does bring a lot of advantages to its user, yet, it also has its own drawbacks. When talking about interactive multimedia on web pages, every browser can display at least some subset of HTML while multimedia elements not as widely supported. To point it out, the absence of Flash multimedia on Apple's mobile devices. In the middle of 2012, sites that depend upon Flash display incorrectly due to the devices such as iPads and iPhones do not support Flash. This problem not only happened on Apple's mobile devices, it also occurred on other types of multimedia. A site that uses the Windows Media format for its multimedia content will frequently not work correctly for users on computers that lack a plug-in for Windows Media (Solomon Poretsky, n.d.).

While discussing about using interactive multimedia in professional communication, it often requires more equipment to deliver a message or content than more traditional medium. There is the certain rate of chance that the equipment will fail to perform. However, time is precious, user do not want to spend much time to fix the equipment such as search a hard drive for a missing multimedia file and others (Bridgette Redman, n.d.).

2.3 Applications of Multimedia

In the past few years, multimedia technology has pushed forward and started to develop in multiple applications to provide the users a platform to perform their desire task or purpose and hit the goals. For example, some educator use application of multimedia to transmit the knowledge and context to learner, some of the user using applications of multimedia for entertaining purpose, while some of the user using multimedia application for healthcare purpose and some of the user use it to perform their business task to achieve the goals.

2.3.1 Multimedia in Education

The learning process can be more interesting and fun in experiences with the help of multimedia to enhance the educational system which could be much better than the traditional way of teaching systems.

In order to support the concept development by learners in multiple ways to meet individual needs, the educator or teaches primary require access to learning resources. The multimedia technologies for learning purpose now can take place in anywhere such as in schools and home. By accessing to the multimedia learning resources, it supports constructive concept development and allows educator to focus more on being a facilitator of learning while working with individual students. Extending the use of multimedia learning resources to the home represents an educational opportunity with the potential to improve student's learning process (Abhaya Asthana, n.d.).

Besides, some the of the learning context sounds hard for student to understand because the knowledge is taught in context form, multimedia provides the visualization helps student to have a better imagination of the content by showing the animation and real world example with the combination of high quality content and friendly interactive method of learning.

2.3.2 Multimedia in Entertainment

Entertainment is defined as diverting or engaging such as a public performance, a usually light comic or an adventure novel. Multimedia in entertainment applications aim at diverting users, engaging them in amazing experiences such as reading a book, listening to music, navigate to a destination, watching videos, and playing a game (Cacciaguerra, Stefano; Marco Roccetti; Paola Salomoni;, n.d.).

In the past few years, passive experiences was offered by traditional multimedia entertainment technology such as video on demand. A greater interactivity is promoted due to the advance of ICT and it allows user having more exciting immersive experiences such as online games,

virtual reality environment, interactive storytelling and others. In fact, with the coming power and efficiency of the Internet era, the network communications can improve the chance to interact and communicate with others in real-time by using the remote applications rather than to sit passively, bringing online the multimedia entertainment (Cacciaguerra, Stefano; Marco Roccetti; Paola Salomoni;, n.d.).

In addition, multimedia in entertainment have across the mobile apps industry such as using smartphones for learning, act as music player, e-book reader, watching video, map navigation and others which bring convenience to user to access the multimedia apps in anywhere with the smart gadgets.

2.3.3 Multimedia in Science/ Medical Science

The area of high-performance and scalable multimedia system is getting more important. One of most important, medical science field, with complex and rapidly growing part of multimedia processing. Medical experts get more used to interact with multimedia content because of their daily live interaction and they want to use it also in their work (Michael Riegler, 2016).

In the daily practice of Scientists, they require a plenty number of technology tools including virtual laboratories and simulations, models of scientific phenomena, and collaborative tools such as e-mail, video conferencing, and online collaborative knowledge bases (Virginija Bireniene, 2014). It is because all these helpful tools aims to support their daily hands-on work done and practices in the laboratory or field as well as other tools enable researchers to observe the process such as protein folding that would be impossible to observe in other ways. (Virginija Bireniene, 2014). Student can practice their routine through the similar technologies which is multimedia programs and tools because they cannot access too many of these tools in the classroom at one time. There are some new ways which student can interact with the information, create visualizations and change content by using the current multimedia technologies. Scientific understandings can often developed by student as a result of their own observations and what they can see to be true (Virginija Bireniene, 2014).

The improvement of multimedia systems performance via GPU-based processing which can help to reach real-time, live multimedia stream processing and low resource consumption which is important for the medical field and can help to save lives (Michael Riegler, 2016).

2.3.4 Multimedia in Business

Multimedia can be an exciting addition to business communication. Its flashiness and fun holds great temptation for the business communicator who wants to add pizazz to presentations,

business plans or even memos (Bridgette Redman, n.d.). "When you think about multimedia platforms and what that is all about, it is about being able to communicate mass marketing messages to the device of choice on demand," says Nissen. "I think what is more interesting is how these tools can be used in conjunction with other multimedia tools to support the business--the marketing, the sales and promotion of their products and services. To me, that, for a small business, is probably more important than internal communication," says Lauren Folino (Lauren Folino & Michelle V. Rafter , 2010).

There are several ways of business company can spread the information about the company and help to increase the reputation in a unique and powerful ways such as mobile marking, live casting or podcasting, file sharing for photo, video and others. This certain type of social media also has the ability to go viral quickly. Hottrix, the Las Vegas, the creator of Nevada-based iPhone app, became one example of a breakthrough success story when their iBeer app, which simulates chugging a mug of beer on the iPhone, became one of the most-downloaded apps in 2008, and again in 2009 (Lauren Folino & Michelle V. Rafter , 2010).

2.4 Multimedia in Mathematics Education

The usage of multimedia in Mathematics education has been risen in the world with different level of learning process such as multimedia in primary school math, multimedia in middle school math, multimedia in high school, and others. Recently, education for learning process include the different kinds of multimedia as it allows the wider spectrum of possibilities in teaching and learning. In order to explain mathematical ideas, abstract terms, theorems, problems and others, visualisation act as a very useful tool in this process (Marina Milovanović, Đurđica Takači, & Aleksandar Milajić, 2012). Teaching and learning process which includes the multimedia software is important, because there are much more possibilities offered by visual presentation. Besides, using multimedia lessons on isometric transformations, students can absorb the knowledge better such as students understand the movements that have led to it instead of just see the final solution (Marina Milovanović, Đurđica Takači, & Aleksandar Milajić, 2012).

For example, some of the mathematics solution is given in the numerical form, students may not fully understand with the text form only. It can be much better when all this numerical solution is explained in animation form. To point it out, students can clearly understand the increasing or decreasing circumstance of an area by having the visual perception in the multimedia lessons.

2.5 Comparison of Similar Multimedia Applications
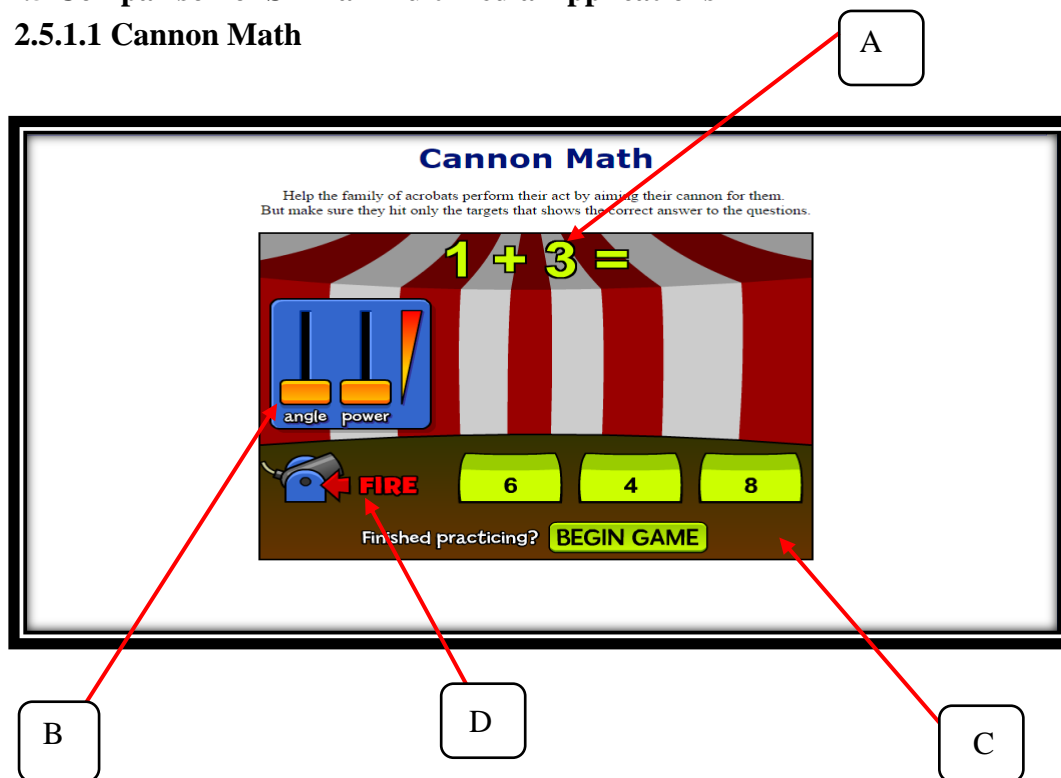**2.5.1.1 Cannon Math**

Figure 2.5.1 Canon Math

As shown in the picture above, it is a very simple design which is suitable for kids to understand the function of every buttons. A very simple addition mathematics question shown in label A and the multiple choice answers are shown in the label C. User have to adjust the angle and power which are labeled in B according to the position of the correct answer and the click on the "FIRE" which is labeled as D to let the boom reach to answer.

Strength

The interface design is very simple to ease the kids understand how does the button work and how to proceed to next step. The question is very simple as well to let the kids calculate the addition mathematic only. Thus, kids only focus on how to answer the addition question.

Weakness

Kids may not understand how to adjust the suitable angle and power to reach to the correct answer. To point it out, when answer is located in the middle, angle has to adjust to the middle but the power too high or too low will make the boom miss out the correct answer. Power and angle must match well in order to reach to the correct answer.

Recommendation

Angle and the power may label with range which is the range is clearly stated that what degree of angle match with how high the power will reach to which position of answer.

2.5.1.2 Brainzy Math and Reading Program Fish Bowl Addition
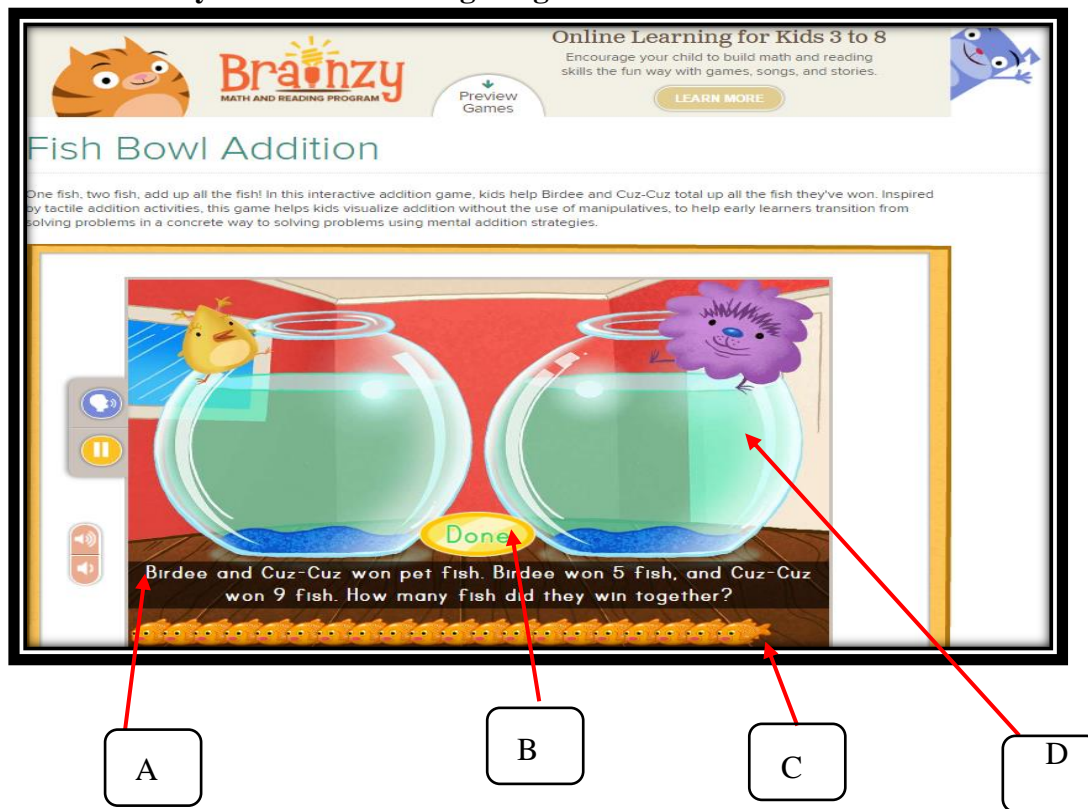

Figure 2.5.1.2.0 Fish Bowl Addition

Brainzy Math and Reading Program is suitable for kids to learn mathematics in mathematical word problems form. A very simple mathematical word problem's question is shown in the label A, based on the question and calculate the correct amount of fish. Next, drag the correct amount of fish in label C to the both aquariums which is labelled as D. Click the "Done" which is labelled as B once user has confirmed the answer.

Figure 2.5.1.2.1 Fish Bowl Addition

Strength

Except of the mathematical word problems question, question in digit form is shown in the label E after the user has answer the question correctly. Thus, kids can learn the same thing in mathematical word problems form and in digit form instead of just learn mathematics in digit form. Besides, addition mathematical word problems not only asking in fish bowl games, subtraction question is provided also after this.

Weakness

It would be a better fish bowl addition game if there are few questions provided instead of one question only because the fish bowl addition game ends once the user has answered the question correctly.

Recommendation

Provide more questions in one game to let kid familiar with the mathematics. Animate the fish once the user has answered the total amount of fish correctly will attract and cheer the kids.
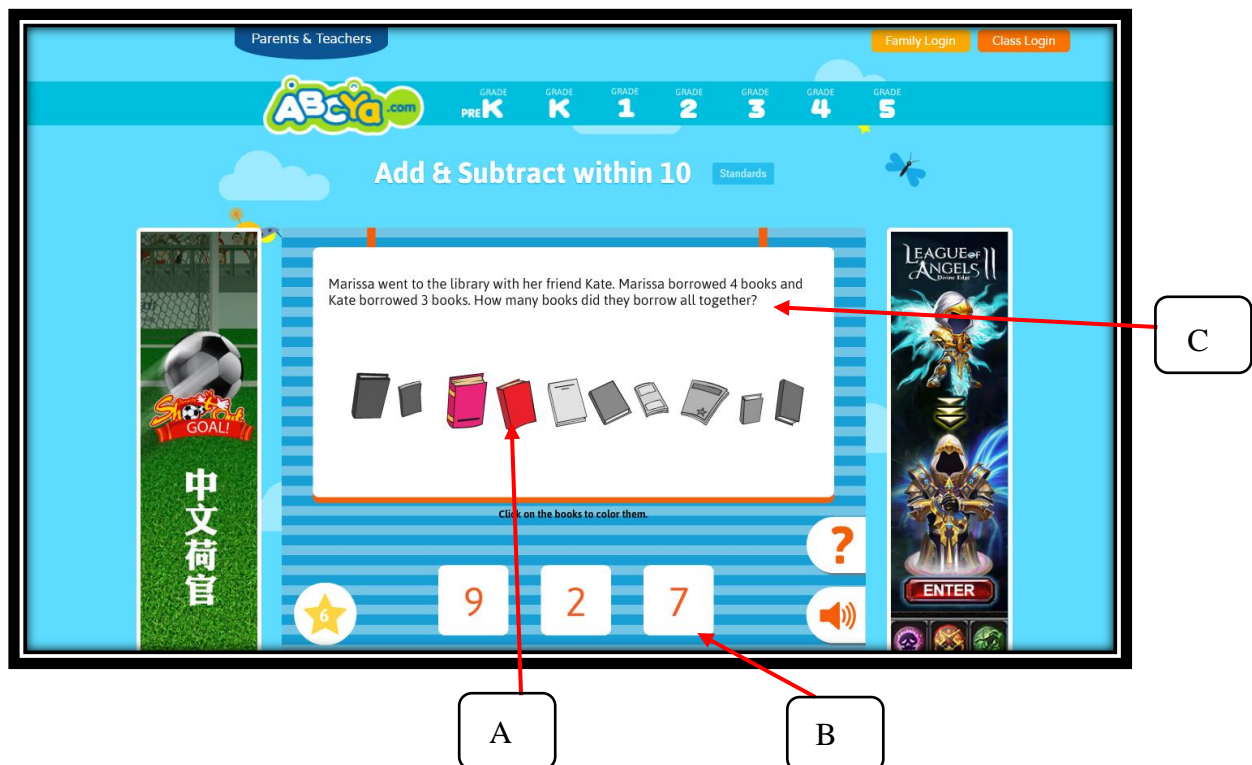
2.5.1.3 ABCYA.com Add & Subtract within 10

Figure 2.5.1.3 ABCYA.com Add & Subtract within 10

Another word problems with manipulates mathematics e-learning as picture shown, ABCYA.com Add & Subtract within 10. In label C which is the question either in addition or subtraction type to ask kids. For label A, user can click on the book or any object in other questions to color them. This is easy for kids to differentiate the object in addition or subtraction question. Multiple choices of answers are shown in the label B. Subtraction or addition questions are randomly pick next after the question is answered correctly.

Strength

It is very attractive as the object can be colored as counting help. In addition question, kids color the object to sum up the total amount, while in subtraction question, kids color the object to take out the object. Hence, kids will learn the addition or subtraction in a very effective way.

Weakness

An attractive advertisement especially games advertisement indirectly reduce the concentration of kids when doing calculation due to the position of advertisement is right and left besides the question and the advertisement is quite big size.

Recommendation

According to the "Z-rule", user normally focus from the right top to the left top then to the center and lastly focus from bottom right to bottom left like "Z". Advertisement can put at the bottom part right after the center where question locate and in small size.

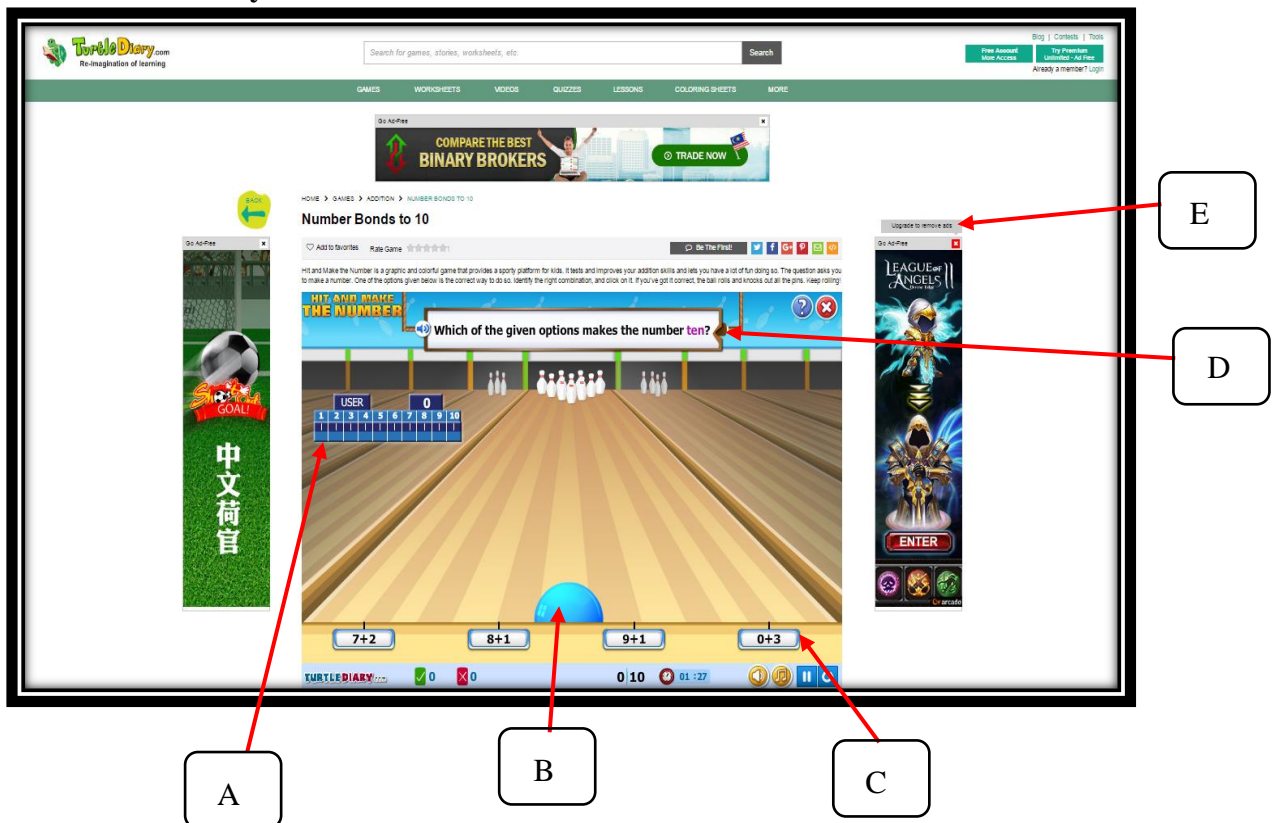### 2.5.1.4 TurtleDiary.com Number Bonds to 10

Figure 2.5.1.4 TurtleDiary.com Number Bonds to 10

A very cute turtle as the TurtleDiary.com icon provides the Number Bonds to 10 game which is rated by user for 4.5 stars. It is just an addition bowling game, read the question carefully in the label D and choose the correct answer in label C. If the answer is correct, the bowling ball will hit all the bowling pins, else the bowling ball will not the all the bowling pins. In label A, marks are allocated there and total up the mark score.

Strength

This bowling game is very suitable for bowling ball's fans. Some kids may not able to play bowling ball as the bowling is too heavy for kids even the smallest bowling also too heavy for some kids. Hence, kids have to answer the question correctly to score more marks and hit all the bowling pins.

Weakness

Same as the previous game, an attractive advertisement especially games advertisement indirectly reduces the concentration of kids when doing calculation due to the position of advertisement is right and left besides the question and the advertisement is quite big size. Advertisement can only close when user upgrade to remove it by paying member fees.

Recommendation

According to the "Z-rule", user normally focus from the right top to the left top then to the center and lastly focus from bottom right to bottom left like "Z". Advertisement can put at the bottom part right after the center where question locate and in small size.

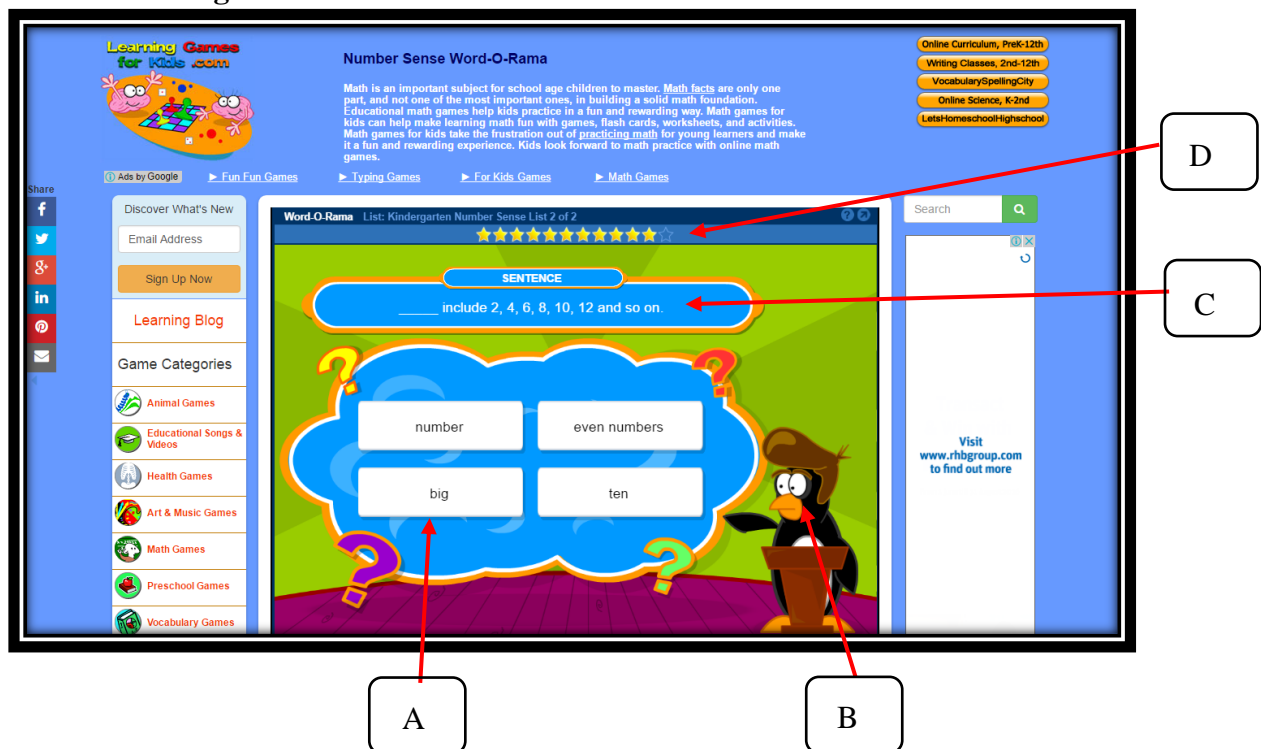**2.5.1.5 Learning Games for Kids.com Number Sense Word O-Rama**

Figure 2.5.1.5 Learning Games for Kids.com Number Sense Word O-Rama

Another type of mathematics e-leaning provided by Learning Games for Kids.com, Number Sense Word O-Rama. As the meaning of the game's name, the questions are all about the number sense word. In label B, cute animated penguin is there to read the question and question in word form is provided also in the label C. Kids have to score full start for the games in label D in order to proceed to next type of game.

Strength

Instead of just leaning the math facts, number sense word also one of important part in building a solid number foundation. Some of the question in Number Sense Word O-Rama is about the definition of word and kids have to find out the exactly number sense word. This type of game strengthens the number foundation of kids.

Weakness

In my opinion, the design color is not bright enough to attract the kids. For example, the dark green color as background color make the interface design look dim and may not 100 percent attract the kids to concentrate well.

Recommendation

The dark green color be replace by brighter or lighter green color as background color which can cheer the kids in doing mathematics.
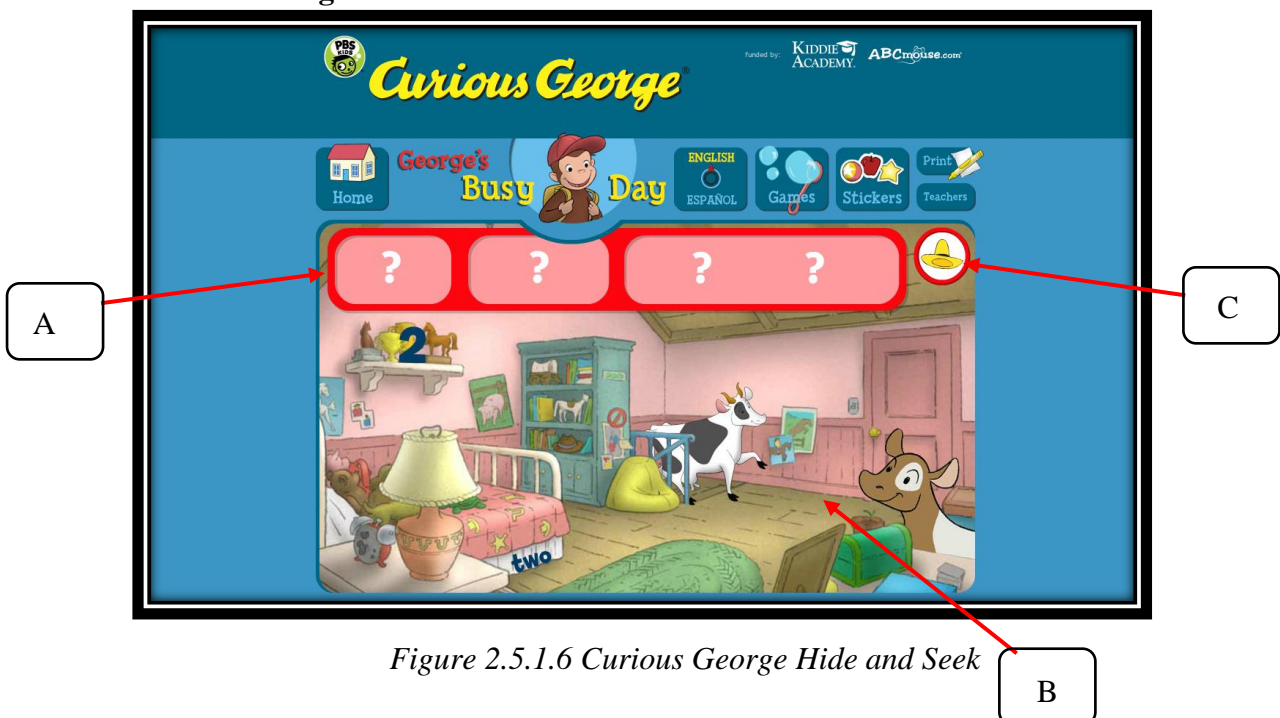
2.5.1.6 Curious George Hide and Seek

Figure 2.5.1.6 Curious George Hide and Seek

Curious George which is a monkey is finding his friends (animal) inside the picture, a very interesting number games, Hide and Seek. In every question, different number is asking in word form, number form and object form or animal form. In label C, a handsome man is over there to speak the instruction and kids have to find the answer inside the picture. Once kids have found the answer, click on the answer and the correct answer will appear on the answer box which is labeled as A.

Strength

Question will keep repeating randomly after zero to ten number's questions have answered correctly instead of just end the game. Question repeated will get the kids familiar with the digit, number word and number of animal.

Weakness

It would be a better hide and seek game if the resolution of the picture can bigger a bit which is making the eyesight of parents who accompany their kids for guiding purpose feel comfortable. Parents with eyesight problem may not feeling comfortable with the small resolution of picture to seek for the correct object as the correct object may looks similar color with another object.

Recommendation

Increase the resolution of the picture for seek and hide to solve the eyesight problems of parents. This will make the process of playing hide and seek more fun and effectively.

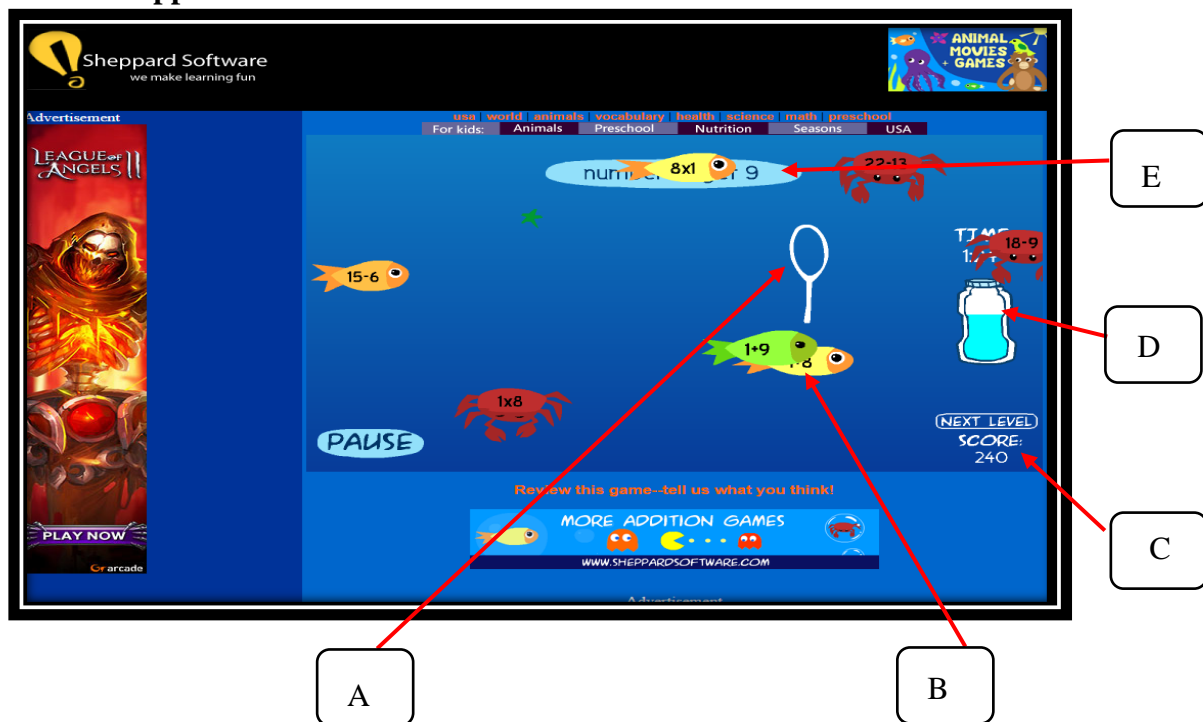**2.5.1.7 Sheppard Software Bubble Fun Math**

Figure 2.5.1.7 Sheppard Software Bubble Fun Math

An addition, subtraction and manipulation mixed bubble fun math game from Shepard Software with the slogan of "we make learning fun". Mathematics question is shown in the label E which are the answer can be in addition, subtraction or manipulation form. Label A, which is a fish catcher tools to catch the fish with the correct answer in the label B. There are the bubbles user click to catch the fish. In label D, the time means the time left for the kids to catch the correct fish for the question and the label C is the total score for the correct answer.

Strength

Kids like to play bubble, the designer take the right point to design the likable bubble math game to grab the interest of kids. The design of answer is adorable which makes the kids have fun while doing mathematics.

Weakness

It is a poor design of animation. In label B, the moving of the answer which are the fishes or crabs will overlap with each other makes the kids feel hard to catch the correct answer. Kids miss out the opportunity to catch the correct answer.

Recommendation

Change the way of the fishes moving so that the fishes will not overlap with each other. Kids can find the answer clearly and catch it easily.

2.5.2 Summary of the Similar Application (Comparison Tables)

Multimedia Application Name	Interface Design			Content (Richness/ Resourceful)	Interactivity
	Navigation	Color	User-Friendliness (Usability)		
Cannon Math	3	4	3	3	3
Fish Bowl Addition	4	4	4	3	4
ABCYA.com	4	4	4	5	4
TurtleDiary.com	4	4	4	4	3
Number Sense Word O-Rama	4	2	4	4	3
Hide and Seek	4	3	3	5	5
Sheppard Software	4	4	3	4	4

1 – Bad   2 – Poor   3 – Average   4 – Good   5 – Excellent

Table 2.5.2.1 Comparison Table 1

Multimedia Application Name	Multimedia Element					
	Audio	Animation		Text	Graphic	Video
		2D	3D			
Cannon Math	Yes	Yes	Yes	Yes	Yes	No
Fish Bowl Addition	Yes	Yes	No	Yes	Yes	No
ABCYA.com	No	Yes	No	Yes	Yes	No
TurtleDiary.com	Yes	Yes	Yes	Yes	Yes	No
Number Sense Word O-Rama	Yes	Yes	No	Yes	Yes	No
Hide and Seek	Yes	Yes	No	Yes	Yes	No
Sheppard Software	Yes	Yes	Yes	Yes	Yes	No

Table 2.5.2.2 Comparison Table 2

Multimedia Application Name	Desktop Virtual Reality	Cost	Target Audience	Comment
Cannon Math	No	Free	Kindergarten	**S:**1)Simple user interface 2)Simple question easy to understand **W:** Hard to reach the correct position
Fish Bowl Addition	No	Free	Primary School Pupils	**S:** 1)Excellent interactivity 2) Question in word problems and digit form. **W:** No animation to increase the effectiveness of learning
ABCYA.com	No	Free	Primary School Pupils	**S:**Can differentiate the object with color **W:**Poor Interface Layout
TurtleDiary.com	No	Free	Primary School Pupils	**S:** Full of content **W:** Poor Interface Layout
Number Sense Word O-Rama	No	Free	Primary School Pupils	**S:** 1)Useful Content 2)Good In interactivity **W:** Poor color design
Hide and Seek	No	Free	Kindergarten, Primary School Pupils	**S:** Useful content **W:** Small resolution of picture
Sheppard Software	No	Free	Primary School Pupils	**S:** Good interactivity **W:** Poor design of animation

S: Strength W: Weaknesses

Table 2.5.2.3 Comparison Table 3

2.6 Learning Approach (Learner Centred Approach)

Computer Aided Instructions (CAI) Mathematics using Learner Centred Approach. A learner centred approach is one where the complete eLearning experience is focused on the learners. For example, the courses need to be very user-friendly, so that learners can navigate the course without any difficulty. They should be able to easily access the content of their choice, and skip the sections they are not interested in. Likewise, learners should find the courses relevant to their challenges and learning needs. The courses should include real life examples that learners can relate to (Anand Timothy, 2015).

Every organization wants to get the maximum benefit from its eLearning initiatives. A key element of any successful eLearning program is to keep the learners engaged in the course. A learner centred approach is a proven way of keeping learners engaged, and thereby ensuring effective eLearning (Anand Timothy, 2015).

2.7 User requirement Data Collection and Analysis
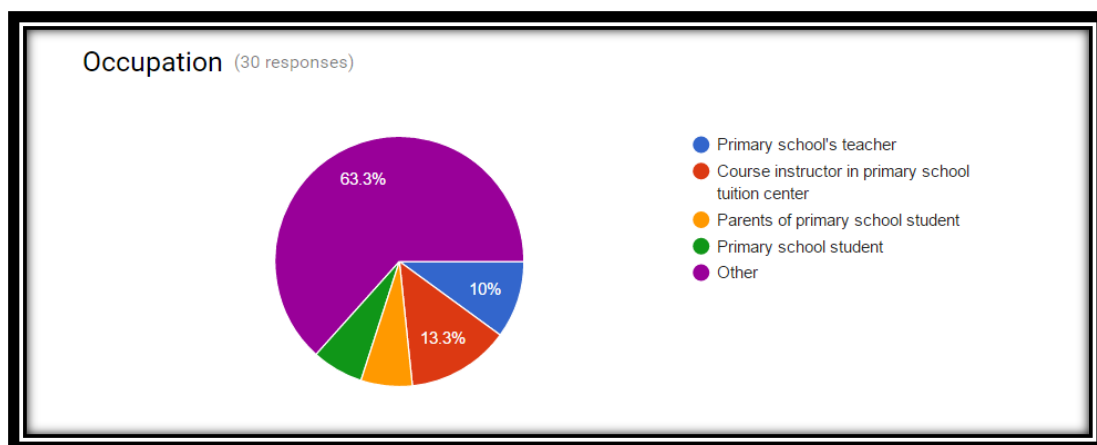
Figure 2.7.1 Occupation of respondent

Throughout the questionnaires, 63.3% of respondent is grouped in other category such as secondary school teacher, student and employee who are experienced the primary school Mathematics learning process in the past. While 13.3% of respondent is course instructor in primary school tuition center, 10% of respondent is primary school's teacher, 6.7% of respondent is parents of primary school student and 6.7% of respondent is primary school student.
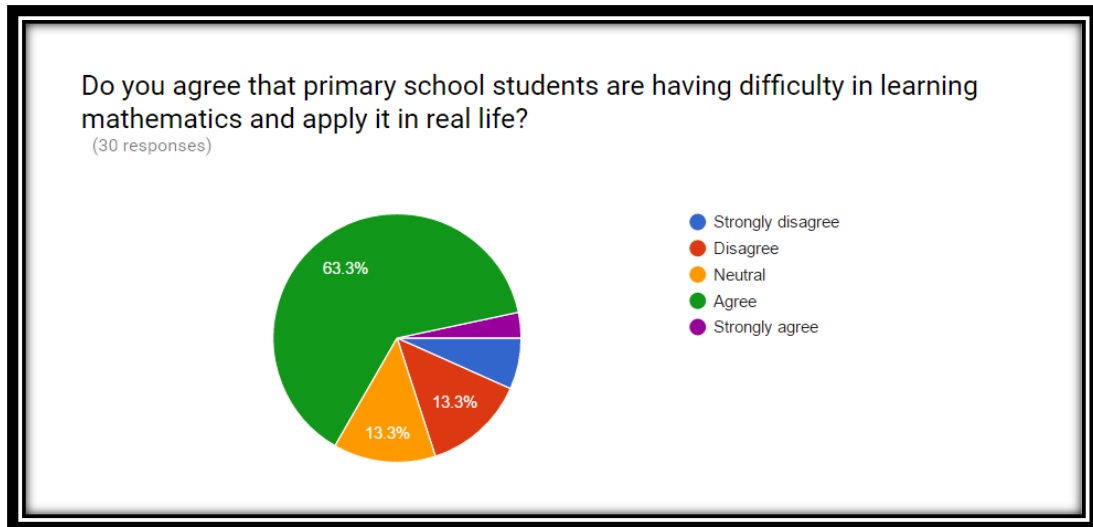
Figure 2.7.2 Experience of respondent

The result of the questionnaires showed that most of the respondent agree that primary school students are having difficulty in learning Mathematics and apply it in real life which are 63.3% of respondent agree and 3.3% of respondent strongly agree. However, 13.3% of respondent chose neutral for the question and the rest 13.3% of respondent disagree and 6.7% of respondent strongly disagree.
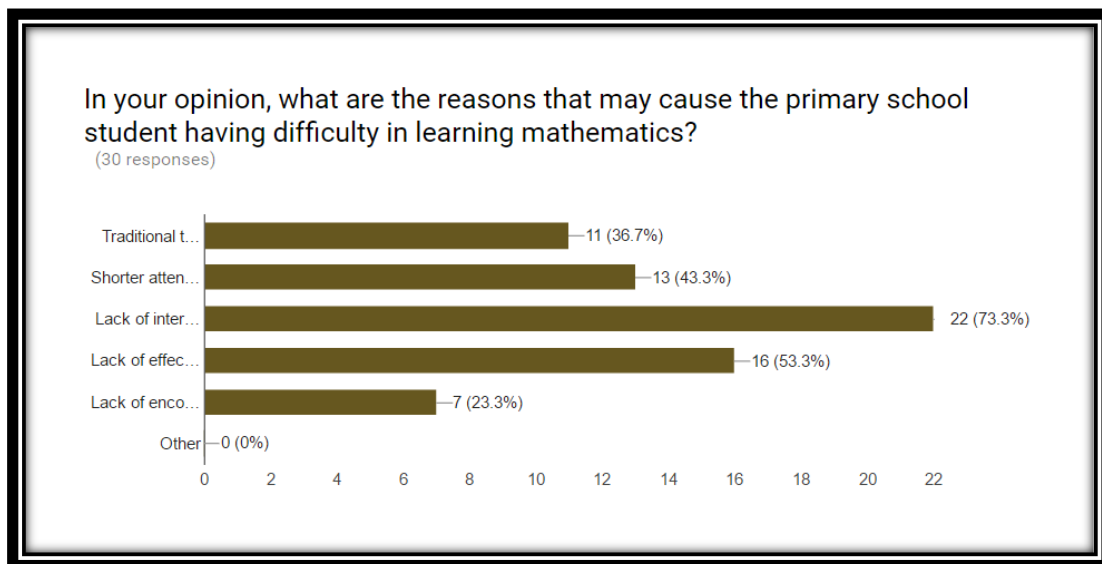

Figure 2.7.3 Opinion of respondent

In the question of the *Figure 2.7.3*, the author seeks for the reasons which causes the primary school student having difficulty in learning Mathematics to prove the problem statement. From the result, lack of interest and motivation is the main reason that cause the primary school student having difficulty in learning Mathematics at 73.3% and follow by lack of effective

teaching tools the second main reason at 53.3%, shorter attention span of primary school student at 43.3%, traditional teaching method at 36.7% and the last one is lack of encouragement at 23.3%.
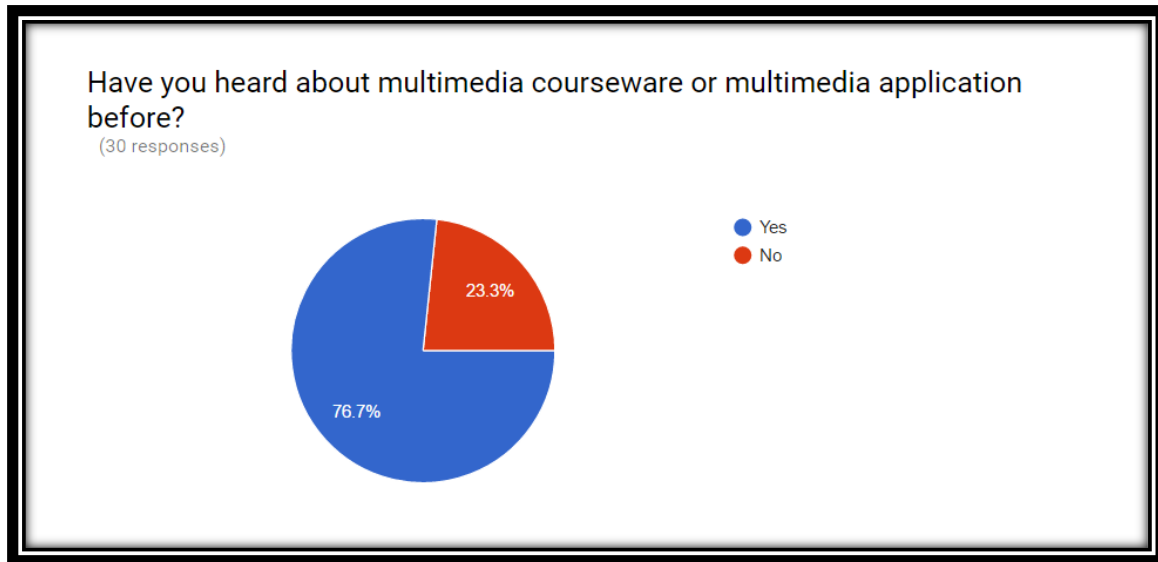
Figure 2.7.4 Experience of respondent for multimedia courseware

From the questionnaires, most of the respondents have heard about multimedia courseware or multimedia application which is 76.7% while the rest of 23.3% have no hear about it.
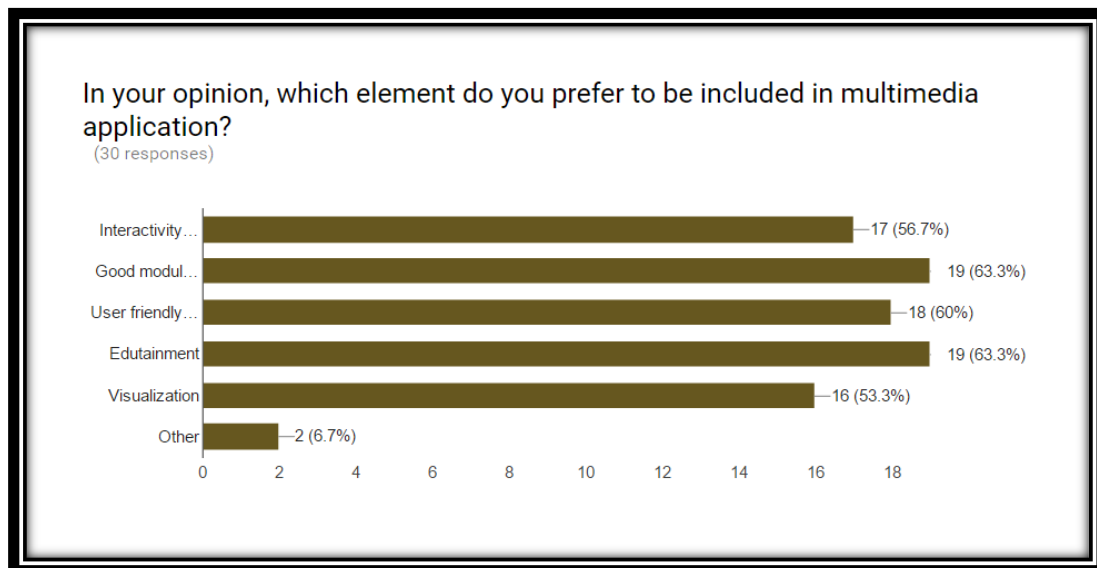
Figure 2.7.5 Opinion of respondent for element in multimedia application

In the questionnaires, almost all elements are preferred by respondent to be included in the multimedia application and the edutainment and good module content have the highest percentage which is 63.3%, follow by user friendly interface design is the second highest

percentage which is 60%, interactivity of application is the third highest percentage at 56.7%, visualization at 53.3% and two respondent prefer the multimedia application includes the user review for the application and multi-language for this application.
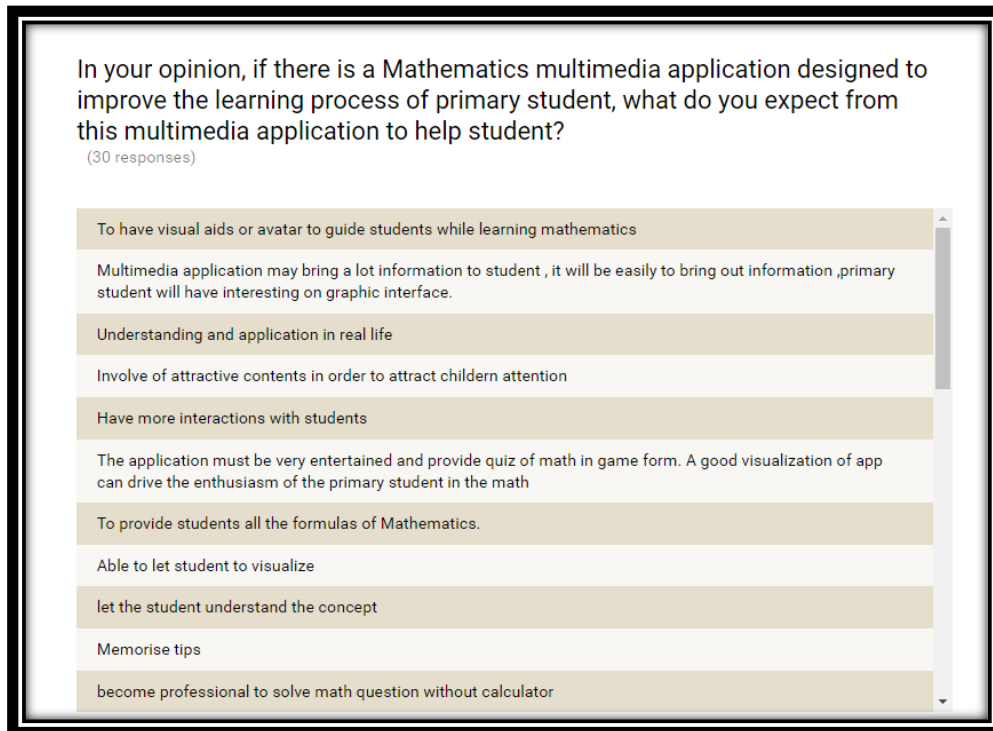
Figure 2.7.6.1 Opinion of respondent for expectation
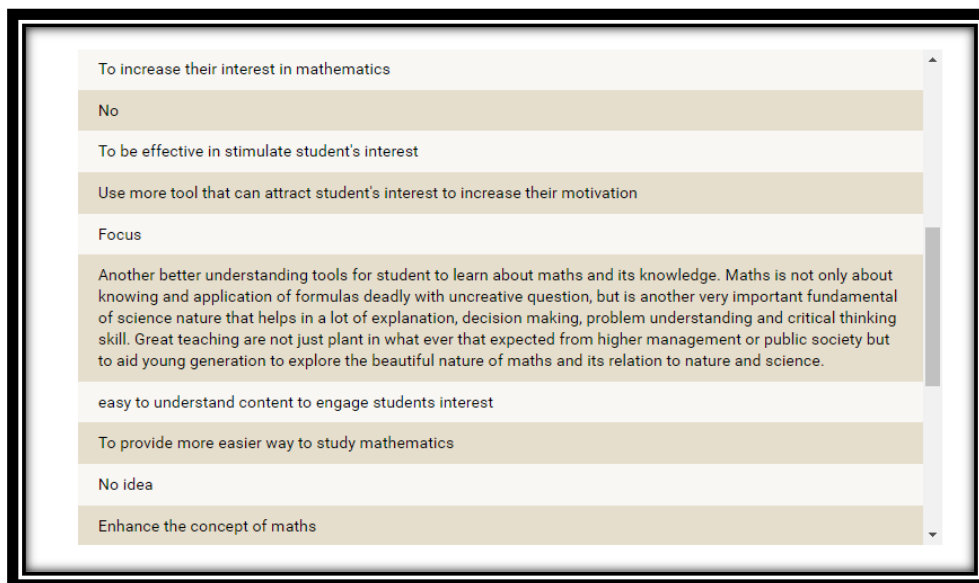
Figure 2.7.6.2 Opinion of respondent for expectation

Enhance the concept of maths
Interesting and fun
Exercise
Combinations of study and entertainment
Design the application in such a way that student is able to learn and play at the same time by using the multimedia application.
I hope student can apply the mathematics in any where not only for exam instead.
I would expect it could attract the attention of those students on mathematics, in the same time the application should be able to displays to students how mathematics knowledge can be use in reality.
Step by step and visualization
There should be more question pools from all verified sources, and provide explanation for each solution given.
Can improve the learnability of student to handle mathematics in exam and in any activities such as counting, drawing, shopping, saving habits and others.

Figure 2.7.6.3 Opinion of respondent for expectation

This question is asking the expectation from the respondent to improve the learning process of primary school student through the Mathematics learning application. A lot of respondents expect the application provides the tips, step-by-step, exercise, formula and concept for the learning process. While some of the respondent expect something from the design of interface which are the application can increase the motivation, interesting, professional of student by having the good module content, interactivity, better understanding tools and edutainment element. There are few respondents think that visualization is important in this application and few respondents have no idea for the expectation.
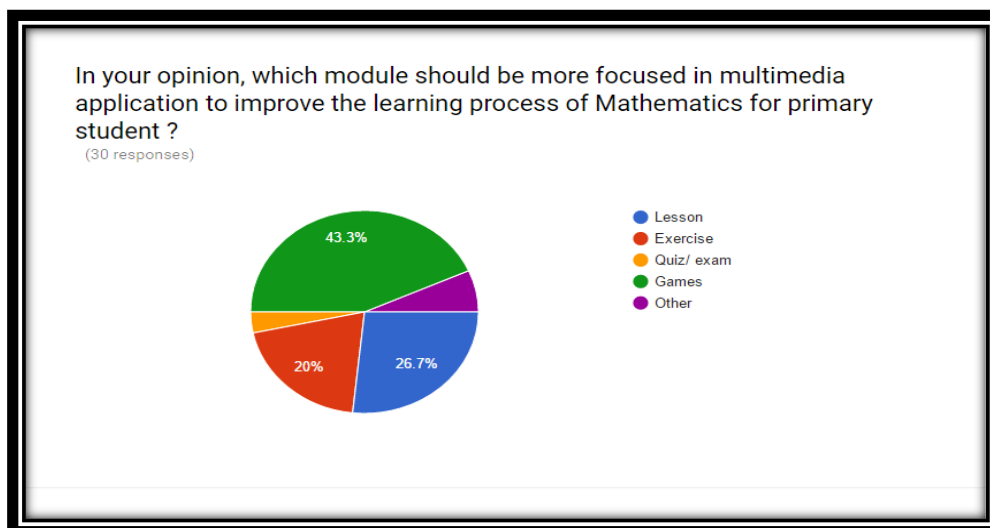
Figure 2.7.7 Opinion of respondent for module in multimedia application

In the opinion of respondent, games module should be more focused in the Mathematics learning application at 43.3%, the highest percentage compare to other module, follow by second module should be focuses is lesson which is 26.7%, the second highest percentage. Next, exercise module is the third important module to be more focused which is 20%, other such as formula explanation story and visualized teach at 6.7% and the last module should be more focuses is quiz or exam which is 3.3%, seems like most of the respondents do not like quiz or exam.
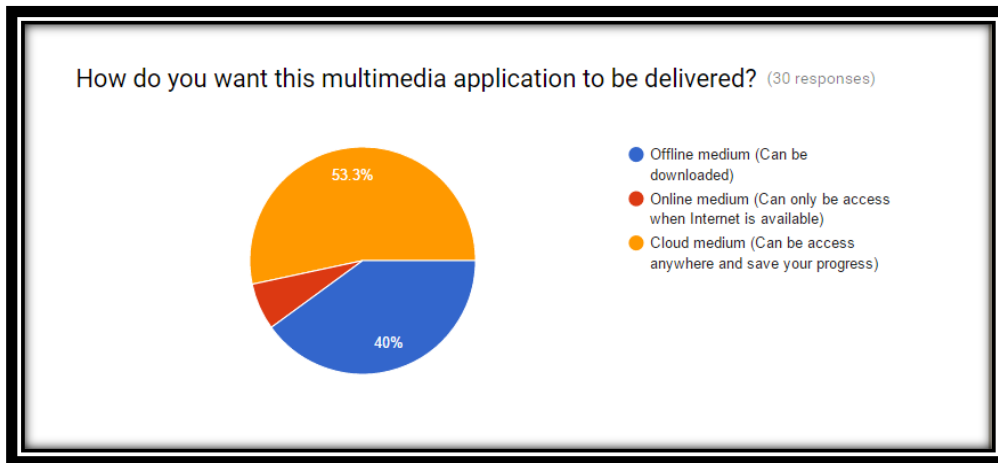
Figure 2.7.8 Feedback of respondent for multimedia application to be delivered

From the feedback of 30 respondent, 53.3% of them prefer the multimedia application to be delivered in cloud medium, 40% of them prefer to multimedia application to be delivered in offline medium and 6.7% of them prefer multimedia to be delivered in online medium.
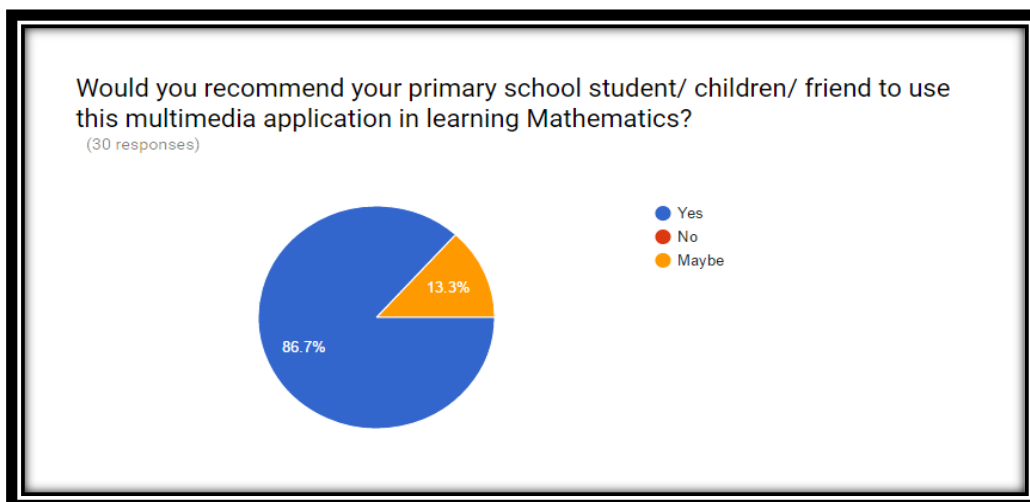
Figure 2.7.9 Feedback of respondent for recommendation

From the feedback of respondent, 86.7% of respondent would like to recommend the Mathematics learning application to the people around them who are suitable to use it and the rest of 13.3% maybe will recommend to the people around them.

CHAPTER 3 SYSTEM DESIGN

3.1 Overview
In the system planned to design, plenty number of software will involve in the pre-authoring stage and authoring stage which is the different type of software required by the multimedia elements such as text, audio, video, graphics and animation. Other than system requirements, there is also the requirement for hardware which are the minimum requirement and optimum requirement to develop a project.

Besides, ADDIE methodology is discussing in the following part to decide which activities to conduct step-by-step in each phase from the beginning until the end of the project in order to control well for the whole project.

The following discussion is about system flow diagram and the storyboard design for the whole project as this planning in storyboard is important to act as a blueprint for the author from time to time when developing the project and demonstrate the algorithm of entire system relation between major parts of the system.

Project planning is discussed also because it is a posting of task milestones, deliverables, activities, and usually with intended start and finish dates of project 1 and project 2. Those tasks are assessed by other information included in the project schedule allocation, linkages of dependencies, task duration and scheduled events.

3.2 System Requirements

3.2.1 Software Requirements
3.2.1.1 Pre- authoring process

Multimedia Element	Software	Description
Text	Microsoft Word, Microsoft Power Point	The software will be used to edit the text for the application such as description, title and tool tips.
Audio	Adobe Audition CS6	The software will be uses to edit and trim the audio file.
Video	Adobe Premiere CS6	The software will be used as editing tool to edit the video and graphics design.
Graphics	Adobe Photoshop CS6	The software will be used to create and edit the images or graphics.
Animation	Adobe Flash CS6	The software will be used to create the interactive animation.

Table 3.2.1.1 Pre-authoring process

3.2.1.2 Authoring Process

Multimedia Element	Software	Description
Authoring	Adobe Director	The software will be used to integrate all the multimedia element in authoring process.

Table 3.2.1.2 Authoring process

3.2.2 Hardware Requirements

✓ Minimum Requirement:

- o Platform: Window 7, Window 8
- o Graphic Card: NVIDDIA Geforce 1GB
- o Processor : Intel i3
- o Memory : 2GB RAM
- o Hard Disk Space : 500GB
- o Audio : 8-bit digital sound, 8-note synthesizer, MIDI
- o Video Display Ports : 640 * 480, 16 colors MIDI I/O

✓ Optimal Requirement:

- o Platform : Window 10
- o Processor : Intel i5, Intel i7
- o Graphic Card: NVIDDIA Geforce 2GB
- o Memory : 8GB RAM
- o Hard Disk Space : 1TB
- o Audio : 16-bit digital sound, 8-note synthesizer, MIDI
- o Video Display Ports : 640 * 480, 65,536 colors MIDI I/O

3.3 ADDIE model

In recent years, "ADDIE" Instructional Design (ID) method is used by educators and instructional designers as a guide in designing and effectively tracking a project's progress, which stands for Analysis, Design, Development, Implementation and Evaluation. Each step or phase have outcome that leading into the next in the sequence and each stage is a clear instruction on its own (Ed Forest, 2014).

3.3.1 Analysis

It is the most important phase in the ADDIE model and can be considered as the "Goal-Setting Stage". During this phase, the designer identifies the learning problem, the goals and objectives, the audience's needs, existing knowledge, set the goals, objectives and any other relevant characteristics. Analysis also considers the learning environment, any constraints, the delivery options, and the timeline for the project (Ed Forest, 2014).

During the Analysis phase of the ADDIE process, the author will focus on collecting data that will impact the requirement of the entire project. The data that will impact the requirement of the project such as the overall background of the participants who will undergo the mathematics

problem solving program, personal and educational information of the target group which is in kids' range. At the end of the program, kids will accomplish the objective of the program which is improve the mathematics problem solving. Limiting factor to the overall goal of the project will be the resources factor such as lack of professional technical skills.

3.3.2 Design

It is a systematic process of research, planning, identifying and specifying the complete design of the course objectives, lesson planning, topic content, training methodology, media, learner exercises, courseware content, and assessment criteria. Typically detailed prototypes and storyboards are developed at this time, and the look, feel, design and content are determined (CHUCKCASTAGNOLO, 2011).

The design phase deals with assessment instrument, content subject matter analysis and media selection. The design phase should be meet developing and evaluating a set of planned strategies targeted for attaining the project goals. There are different types of media to be uses such as audio, animation, text and graphics are prime example. Teaching learning material will be provided by the author. While the available resources at the author's disposal for completing the project is technical and support from the supervisor. The types of the program to be generated during the study will be an interactive type. Topics are linear in progression which is in easy level for kids. Besides, the user interface will employ in the kind of interesting and colorful to grab the attention of kids.

3.3.3 Development

The Development stage starts the production and testing of the methodology being used in the project. The actual creation of the content and learning materials based on the Design phase. It is important to include whoever is responsible for which elements, time schedules, and deadlines. In this phase, all audio, video, and courseware materials are collected, prepared, created and ready to be tested. If e-learning is involved, programmers develop or integrate technologies. Testers debug materials and procedures. The project is reviewed and revised according to feedback (Ed Forest, 2014).

All the materials will be produced up to task on what the author was intended. Next, the author will integrate all the multimedia elements by using the multimedia software such as Adobe Director and Adobe Illustrator.

3.3.4 Implementation

The phase where the developed course is actually put into action and the final product, developed based on needs and errors discovered while testing with a prototype product, is presented to the target audience (CHUCKCASTAGNOLO, 2011). A procedure for training facilitators and learners on how to best interact with the program content is needed. "Train the Trainer" sessions should cover the course curriculum, learning outcomes, method of delivery, and testing procedures. Preparation of the learners include training them on new tools, student registration. After presenting, the effectiveness of the training materials is evaluated.

Beta version will be given from the author to client for testing purpose. From the beta version, the author will collect the feedback from the client. So, the author will base on the client feedback to enhance the beta version to fulfill the client satisfaction. Implementation will go for a small scale instead of large scale. Technical problems such as shut down of hardware or software arise the author to have another backup tool and plan. Target audience can work independently with the given material thus there is no required of guidance.

3.3.5 Evaluation

The last stage of the ADDIE method is Evaluation, a systemic process, considers feedback from the learners. The feedback gathered during this phase measures reaction, identifies what is working and not working, determines the effectiveness and quality of the delivery, and is designed to fine-tune the program. It validates whether the course satisfied its objectives and the effectiveness of the training materials used. It finds out whether the learning went as planned, and it may also uncover any obstacles that may have emerged, then, by making revisions, adjustments and corrections as needed, insures the success of the next presentation (CHUCKCASTAGNOLO, 2011). This phase consists of formative and summative evaluation. Formative evaluation is present in each stage of the ADDIE process. Summative evaluation consists of tests designed for criterion-related referenced items and providing opportunities for feedback from the users. Revisions are made as necessary (Johnson, n.d.).

During this phase, the author is going to test the entire system for error or bugs. If the system has any problem, the author will solve it in this phase before launch out the final version. Besides, determine the categories at which the effectiveness of the project can be established such as improve learning and better motivation. Method of analyzing and grading the response from the participants on the project for improving purpose is based on the rating, survey and

feedback. Kids and parents get to receive the final output project as there are the targeted audience.

3.4 System Flow Diagram
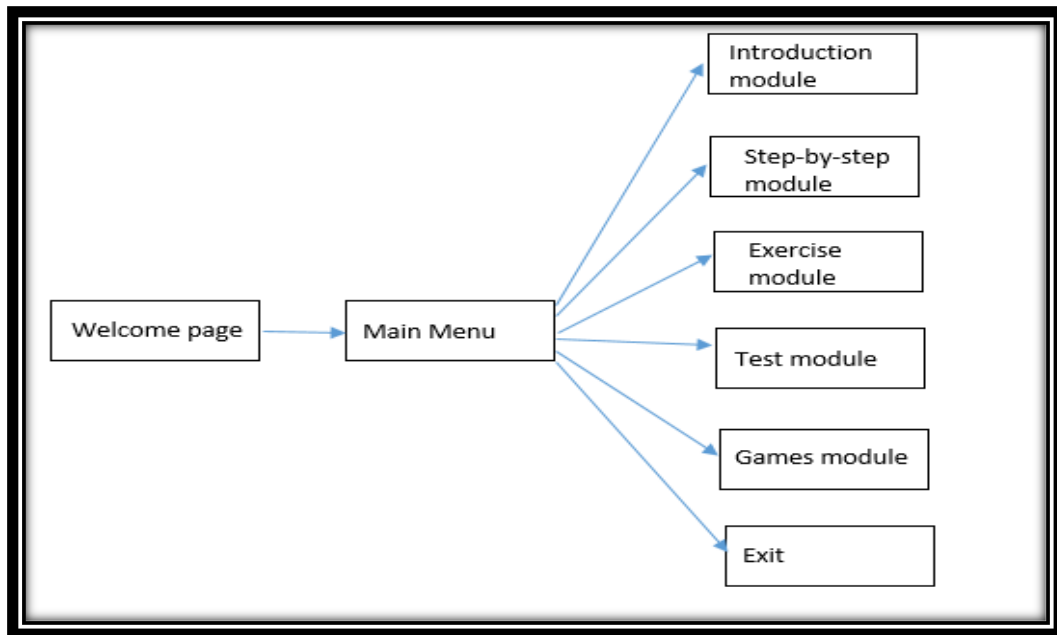
Figure 3.4 System diagram flow

3.5 Storyboarding Design
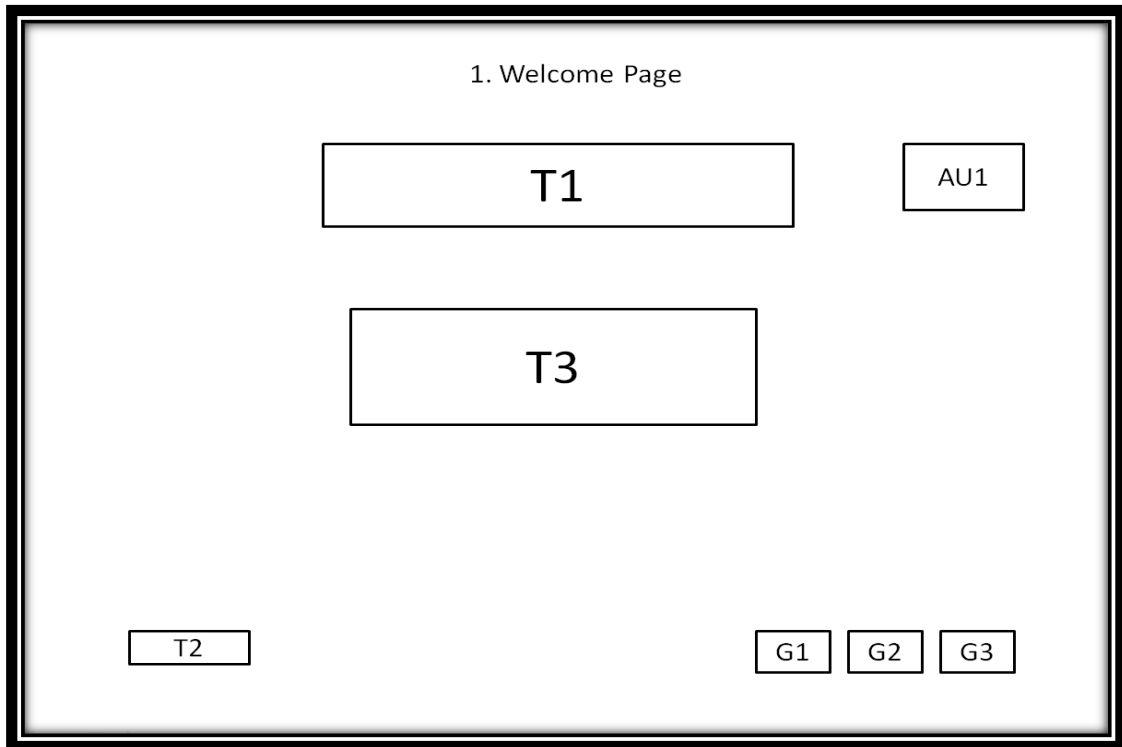
Figure 3.5.1 Welcome page

Element	Description
T1	Refer to the text element that displays the "Welcome" text in this page.
T2	Refer to the text element that displays the "Click anywhere to continue" to skip this page to main menu.
T3	Refer to the text element that display the description of the project.
Au1	Refer to audio element that displays the background music.
G1	Refer to graphic element that displays the volume adjuster button to adjust the volume.
G2	Refer to graphic element that display mute button that allow user need to mute the audio.
G3	Refer to graphic element that displays the help button that allow user click when they want to seek for more information to help.
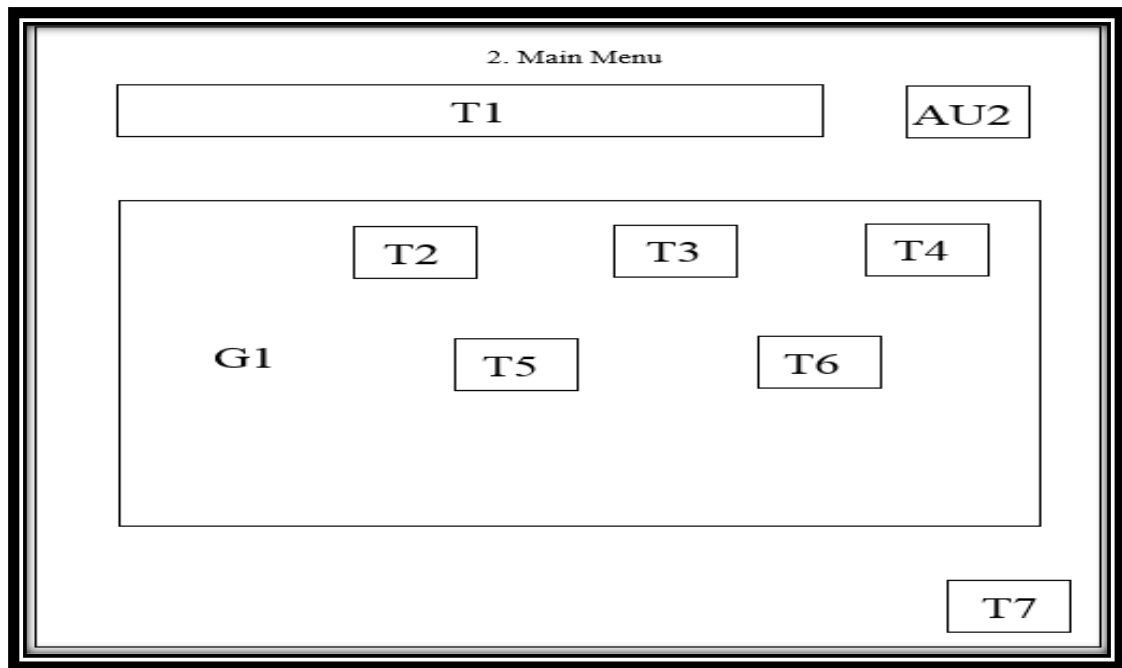
Figure 3.5.2 Main Menu

Element	Description
T1	Refer to text element that displays the title of the project.
T2	Refer to the text element that display button to let user link to "Introduction module".
T3	Refer to the text element that display button to let user link to "Step by step module".
T4	Refer to the text element that display button to let user link to "Exercise module".
T5	Refer to the text element that display button to let user link to "Test module".
T6	Refer to the text element that display button to let user link to "Game module".
T7	Refer to the text element that display button to let user quit the application.
G1	Refer to the graphic element that display the picture which is related to theme of the application.
AU2	Refer to the audio element that display as background music in this page.
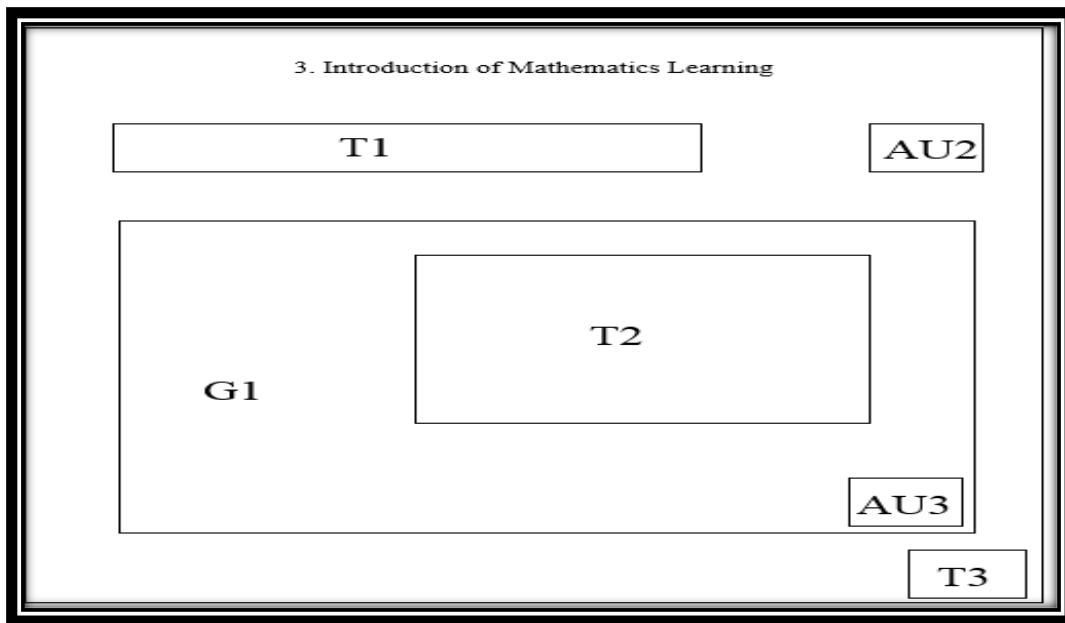
Figure 3.5.3 Introduction module

Element	Description
AU2	Refer to the audio element that display as background music in this page.
AU3	Refer to the audio element that displays the avatar sound for explanation.
G1	Refer to the graphic element that displays some hints for user to explore.
T1	Refer to text element that displays the text of "Introduction of Mathematics Learning".
T2	Refer to text element that displays the description of the hints selected.
T3	Refer to text element that displays the button to allow user link back to main menu.
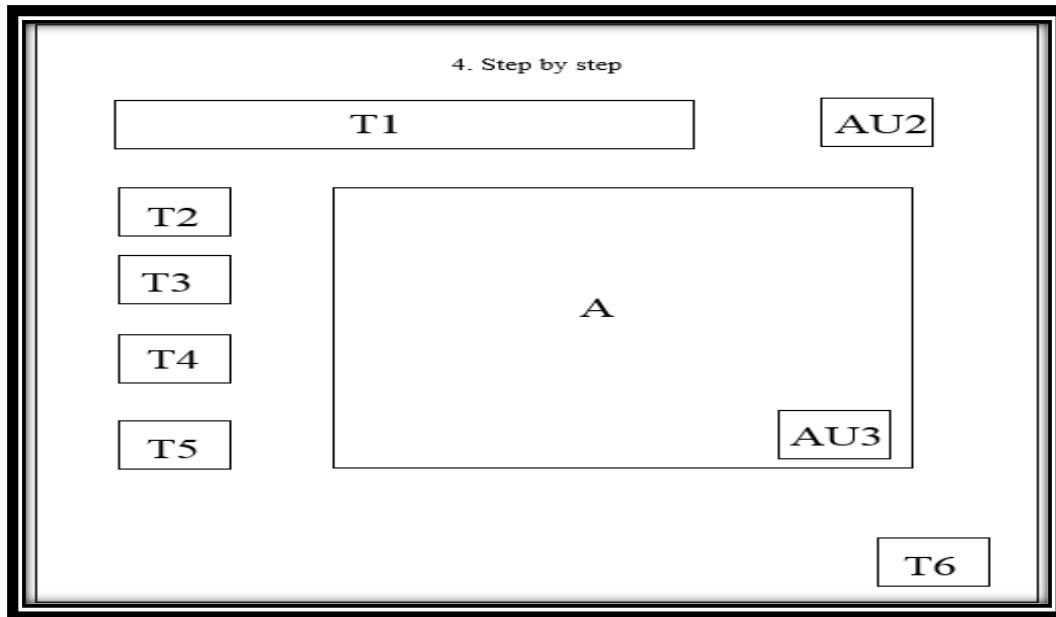
Figure 3.5.4 Step by step module

Element	Description
AU2	Refer to the audio element that display as background music in this page.
AU3	Refer to the audio element that displays the avatar sound for explanation
A	Refer to animation element that displays the step of mathematics learning.
T1	Refer to the text element that display "Step by Step Learning".
T2	Refer to the text element that displays the topic to let user select.
T3	Refer to the text element that displays the topic to let user select.
T4	Refer to the text element that displays the topic to let user select.
T5	Refer to the text element that displays the topic to let user select.
T6	Refer to text element that displays the button to allow user link back to main menu.
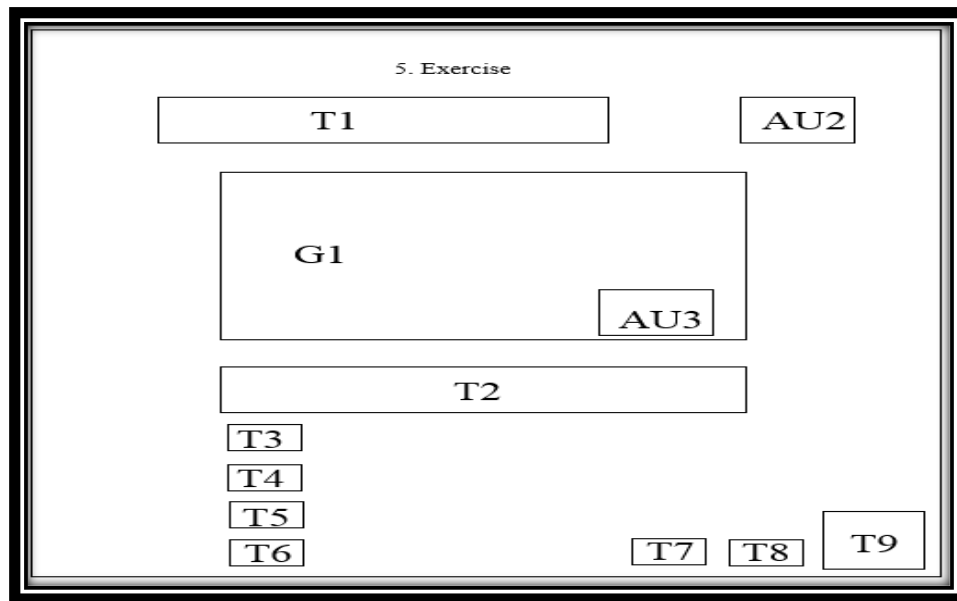
Figure 3.5.5 Exercise module

Element	Description
AU2	Refer to the audio element that display as background music in this page.
AU3	Refer to the audio element that displays the avatar sound for the question.
G	Refer to graphic element that displays the related picture of the question.
T1	Refer to the text element that display "Exercise".
T2	Refer to the text element that displays the question.
T3	Refer to the text element that displays the multiple choice of answer.
T4	Refer to the text element that displays the multiple choice of answer.
T5	Refer to the text element that displays the multiple choice of answer.
T6	Refer to the text element that displays the multiple choice of answer.
T7	Refer to the text element that displays the back button to return to the previous page of question.
T8	Refer to the text element that displays the next button to return to the previous page of question.
T9	Refer to text element that displays the button to allow user link back to main menu.

Figure 3.5.6 Test module

Element	Description
G	Refer to graphic element that displays a clock to show the time left for user to answer the test question.
T1	Refer to the text element that display "Test".
T2	Refer to the text element that displays the test question.
T3	Refer to the text element that displays the multiple choice of answer.
T4	Refer to the text element that displays the multiple choice of answer.
T5	Refer to the text element that displays the multiple choice of answer.
T6	Refer to the text element that displays the multiple choice of answer.
T7	Refer to the text element that displays the back button to return to the previous page of question.
T8	Refer to the text element that displays the next button to return to the previous page of question.
T9	Refer to text element that displays the button to allow user link back to main menu.

Figure 3.5.7 Game module

Element	Description
G1	Refer to graphic element that displays an abacus for user to answer the game question.
G2	Refer to graphic element that displays an abacus for user to answer the game question.
T1	Refer to the text element that display "Game".
T2	Refer to the text element that displays the game question.
T3	Refer to the text element that displays the result of the game question.
T4	Refer to text element that displays the button to allow user link back to main menu.
AU2	Refer to the audio element that display as background music in this page

3.6 Project Planning

3.6.1 Project 1
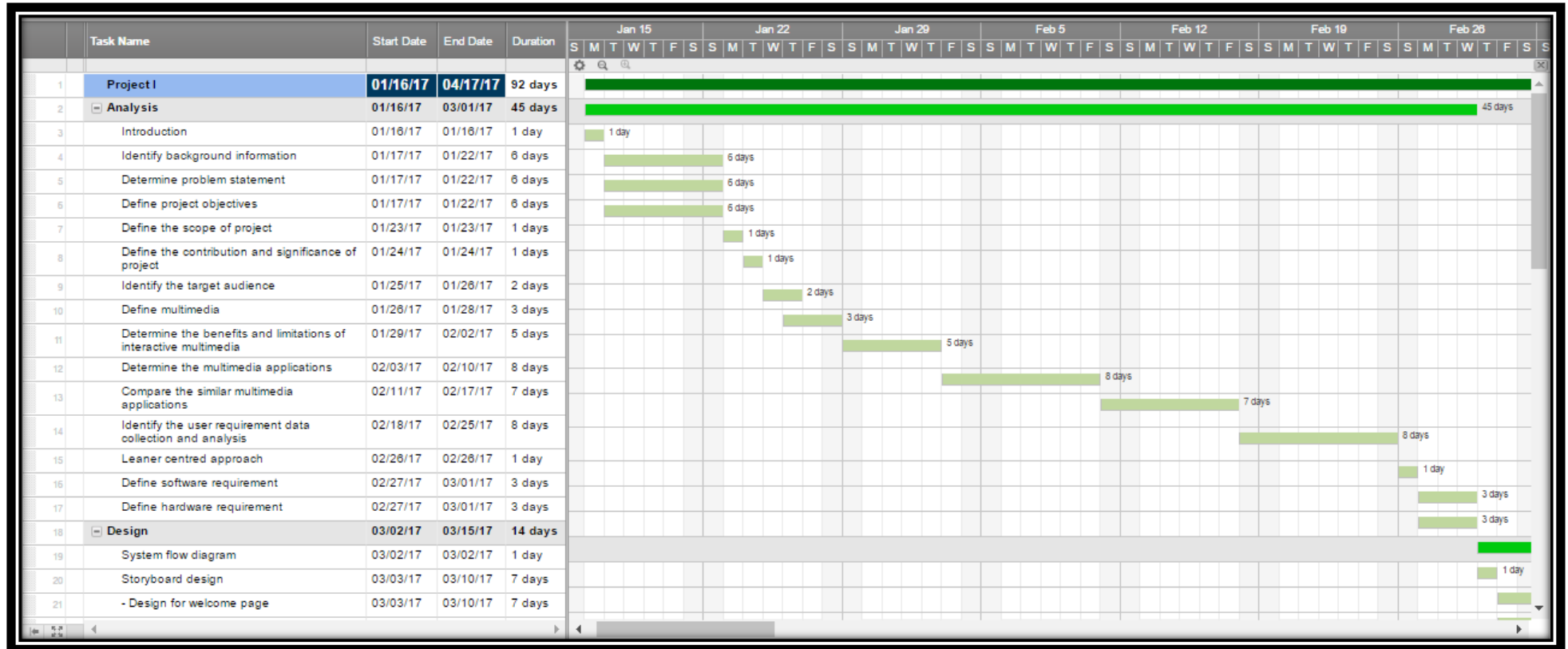
Figure 3.6.1.1 Project planning for project 1
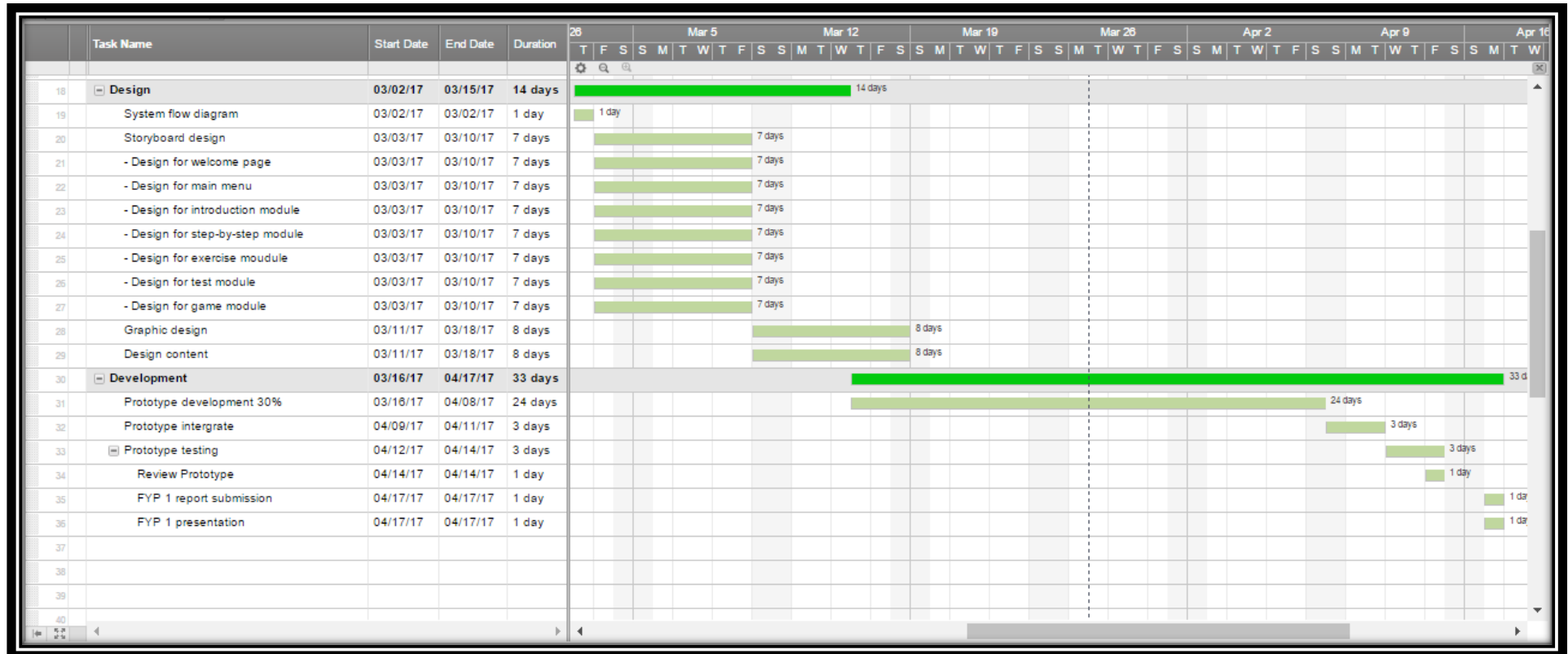
Figure 3.6.1.2 Project planning for project 1

3.6.2 Project 2

	Task Name	Start Date	End Date	Duration
37				
38	**Project 2**	05/29/17	08/28/17	92days
39	⊟ **Development**	05/29/17	07/31/17	64 days
40	System develop 70%	05/29/17	07/31/17	64 days
41	⊟ **Implement**	08/01/17	08/19/17	19 days
42	Review FYP1 report	08/01/17	08/02/17	2 days
43	Analyze FYP1 report problem	08/03/17	08/04/17	2 days
44	Analyze FYP1 prototype problem	08/05/17	08/07/17	3 days
45	Improve interface design	08/08/17	08/17/17	10 days
46	System intergration	08/18/17	08/19/17	2 days
47	⊟ **Evaluation**	08/20/17	08/28/17	9 days
48	System Testing	08/20/17	08/22/17	3 days
49	Interview	08/23/17	08/24/17	2 days
50	⊟ Enhance system	08/25/17	08/26/17	2 days
51	Review system demo	08/27/17	08/27/17	1 day
52	FYP2 report and system submission	08/28/17	08/28/17	1 day
53	FYP2 presentation and system demonstration	08/28/17	08/28/17	1 day
54				
55				
56				

Figure 3.6.2.1 Project planning for project 2

Figure 3.6.2.2 Project planning for project 2

CHAPTER 4 DEVELOPMENT
4.1 Overview

There are three types of process in the development stage which pre -authoring process, authoring process and post-authoring process. In the pre-authoring process, the author prepares right and suitable materials and set the materials ready to use in the authoring process, the preparing process could be included the downloading materials, creating materials and modifying materials using different software and resources to help to complete the process.

While the authoring process is the process of integrate all the ready materials and elements such as animation, audio, graphics and text to create an application as the objective stated. The integration of all materials is done in one software and next proceed to post authoring process which is deliver the application by choosing the suitable and best medium to audience and target user.

All the materials will appear in the simple and easy to understand term because it aims primary school student and complex materials will increase the burden of understanding in the learning process.

4.2 Development
4.2.1 Pre-Authoring Process

4.2.1.1 Process of Creating and Editing Text

Text, one of the element of multimedia elements, act as an important role to convey and deliver the message and content to audience directly. Text design used in the appropriate way might give a good experience when using the application and mostly will assist the user to continue using the application for further exploration of information in the application. Thus, choosing the right font types, font size and colours are important according to the demand of user or natural behaviour of user.

There are two font types of text which are sans serif without strokes or edge and serif with the little strokes or edge. Sans serif is used in this application because the near uniform width of the strokes keeps the font easy to read when it reduces the resolution and font size. Besides,

sans serif fonts are more legible from the farther away which is good for slides, web or any work in softcopy.

The software used to create the text for this application is Microsoft Power Point. The special font types are downloaded from the internet for the nice appealing of font and suit the theme of the application. Downloaded font types are installed to the Microsoft Power Point, text is created and can be saved as picture in the format of PNG (Potable Network Graphics) easily in Microsoft Power Point. The size of the font is also important to grab the attention of the user, it has to be created in the right size for the user to feel readable and comfortable when reading the text.
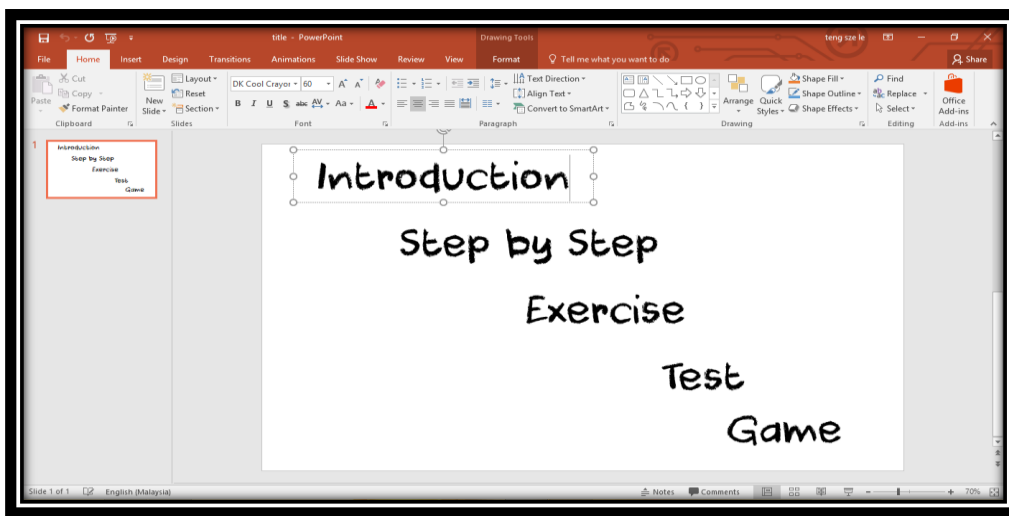
Figure 4.2.1.1 Process of creating and editing text

4.2.1.2 Process of creating and editing graphics

Other than text content, there is graphic to represent the non-text content to deliver the message to audience in one image or few images such as images, graph, drawing and phots because a simple graphic worth a thousand words.

Graphics in this application is generated from many resources such as download from Google, freepik website, capture using smart phone and edit using Adobe Photoshop to match the needs of application. Sometimes, editing and modification is needed to ensure it is suitable for the theme of the application. Adobe Photoshop provides a lot of editing functions which are useful function for modifying the image of this application such as resize the images, magnetic crop, edit text on images, blending and remove the watermark.
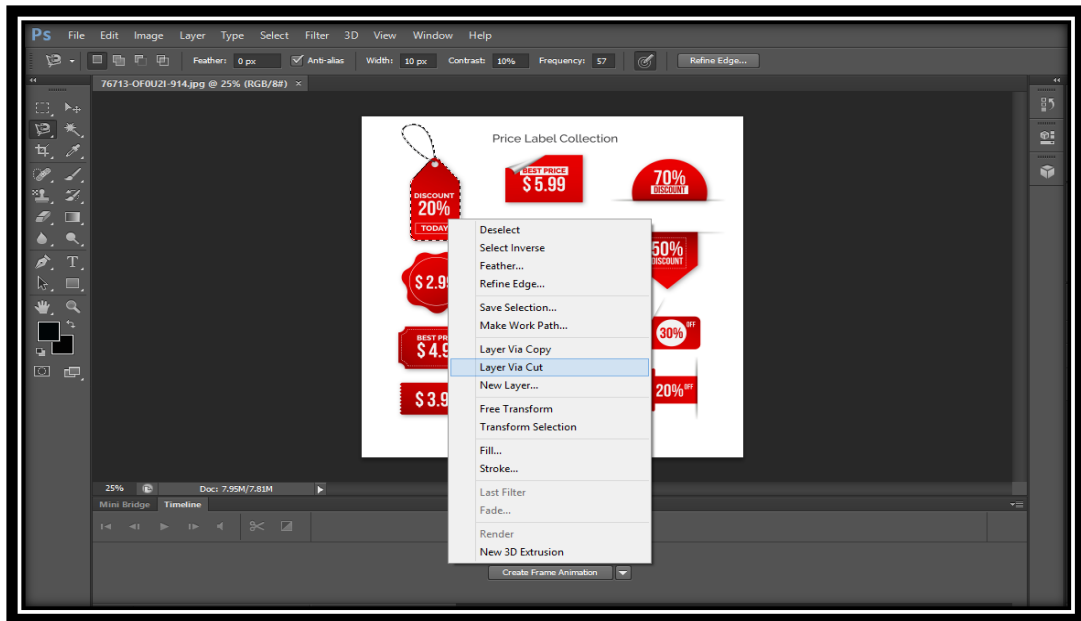
Figure 4.2.1.2.1 Process of cropping graphics
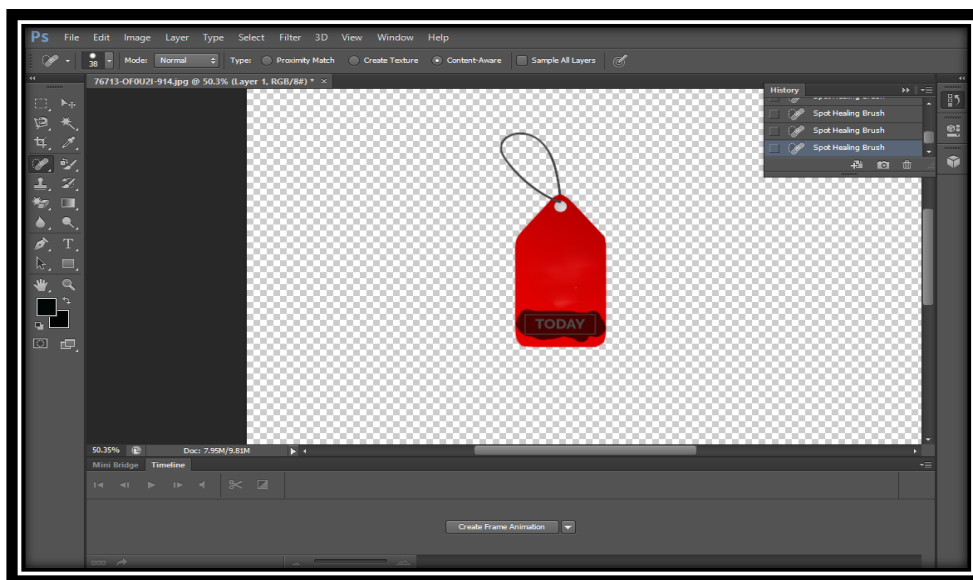
Figure 4.2.1.2.2 Process of removing watermark for graphics

4.2.1.3 Process of creating and editing animations

The animation is used to catch the attention of user. There are two types of animation used in the developing this application which are cel-based animation and path-based animation. The cel-based animation is sued in developing the main menu button for the application. It is created

by using the Adobe Photoshop. There are several images arranged in a sequence with each in a new layer. Some of the process of creating the cel-based animation is shown as below.
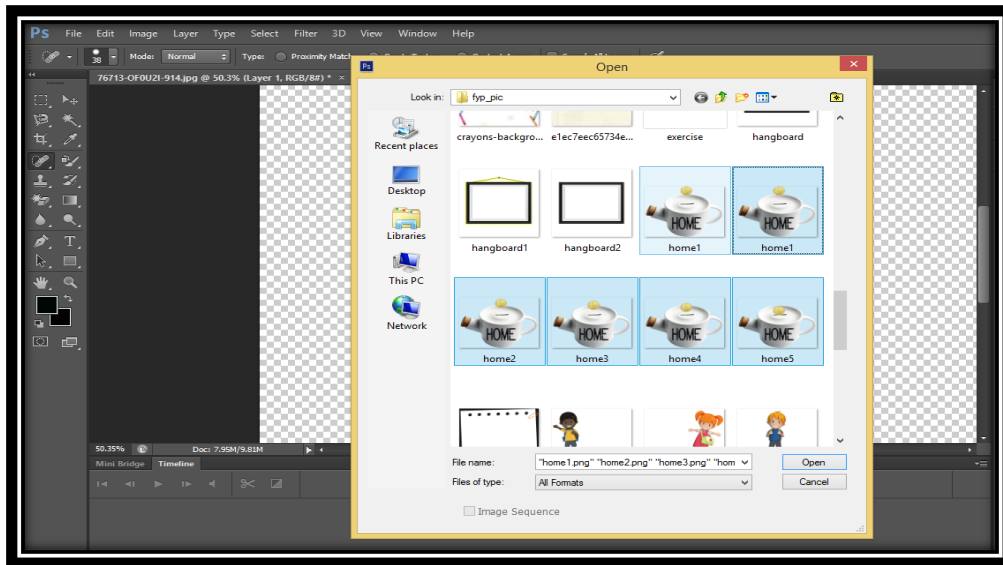
Figure 4.2.1.3.1 Creating cel-based animation using Adobe Photoshop part I
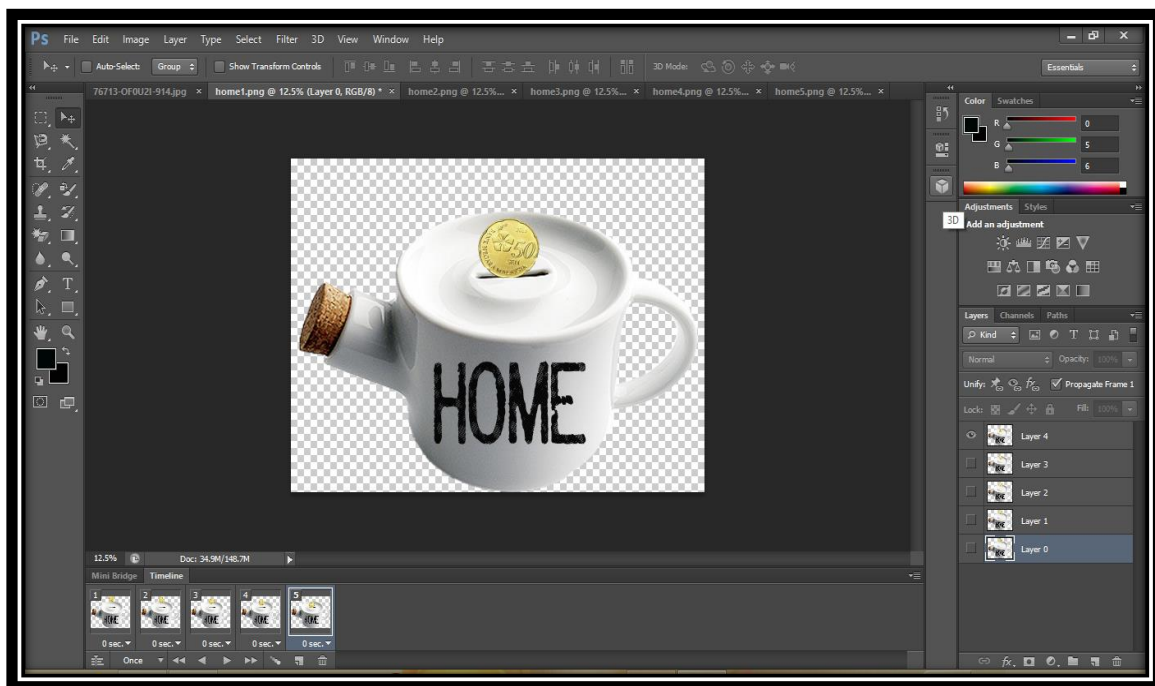
Figure 4.2.1.3.2 Creating cel-based animation using Adobe Photoshop part II
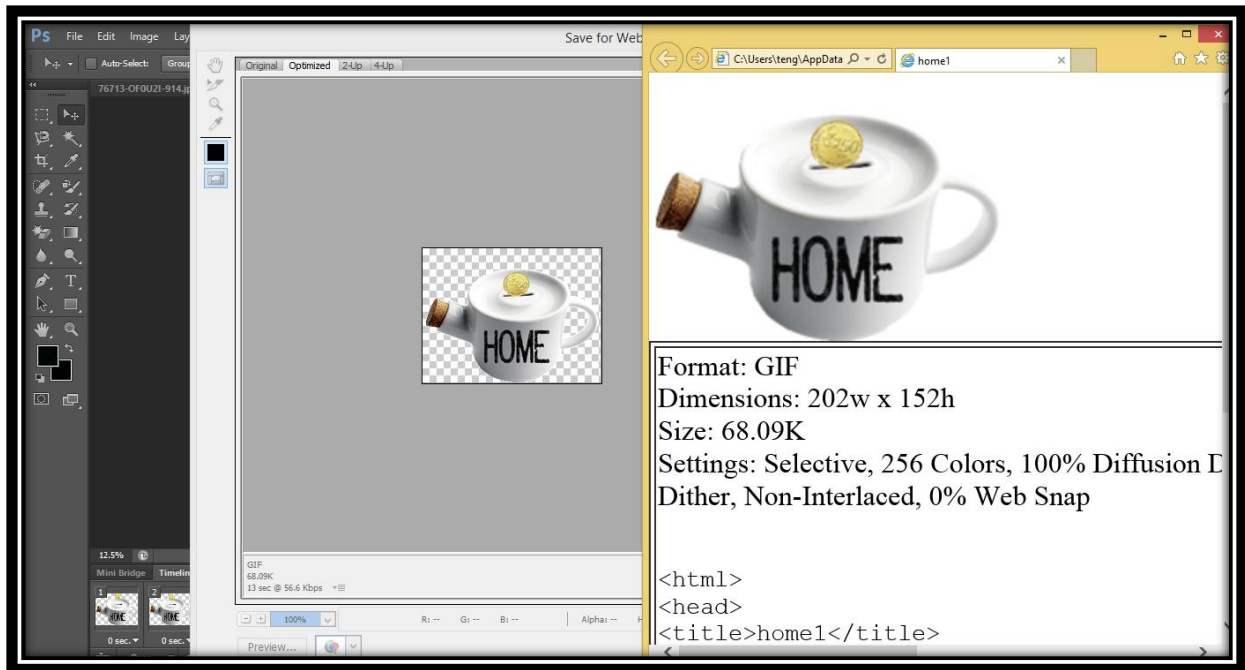
Figure 4.2.1.3.3 Creating cel-based animation using Adobe Photoshop part III

The path-based animation is created on the Macromedia Director MX 2004 during the authoring process. In this application, the path-based animations are used in splash screen module which are the bus in the figure below.

. Figure 4.2.1.3.4 Creating path-based animation using Macromedia Director MX 2004

4.2.1.4 Process of editing audio

Audio, one of the important element also in the preparing materials process. It can act as the special effect sound to get the attention from the audience, as background music to set the mood, and also as a voice narration to provide instructions and explanations because when text and audio work together will increase the absorption of user.

In this application, audio is used as background music which sounds happily while using this application, sound effects for the animation part, sound effects for the button, text to speech narrator for some modules. The sources to get the background music and sound effect is from YouTube and the narration is generated from text to speech website.

Next, the sound effects are also used for indicating an action has been performed. For example, when the users mouse over or click a button, it will play a special sound effect. This is to keep users informed that the particular button has been clicked and avoid users from clicking too many times which may cause error happens.
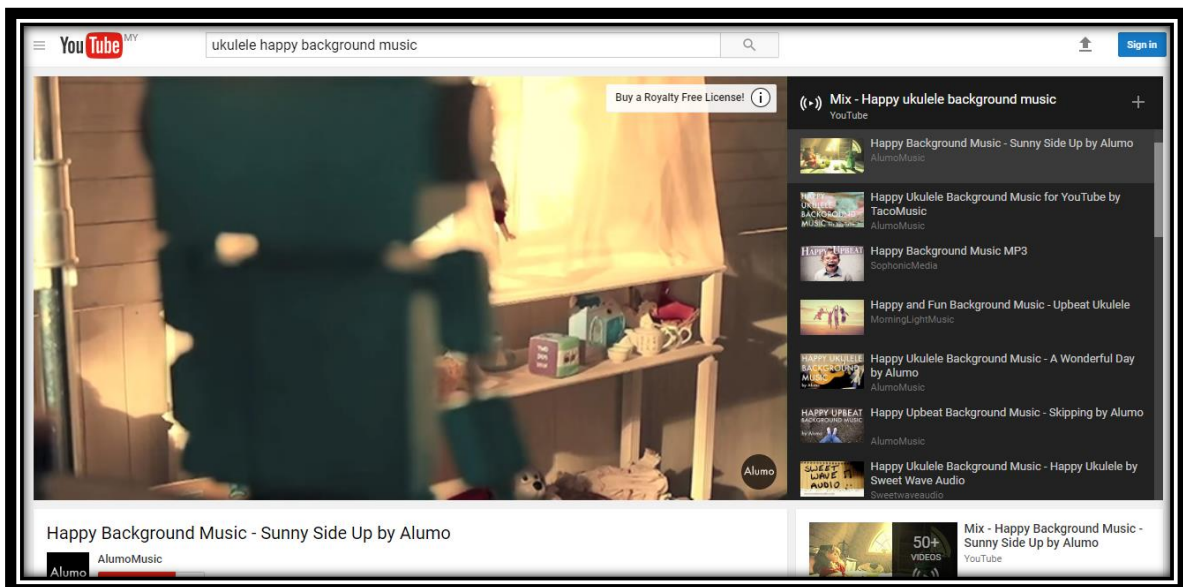
Figure 4.2.1.4.1 Background music from YouTube

Figure 4.2.1.4.2 Online generator of text to speech

4.2.2 Authoring Process

4.2.2.1 Splash Screen Design

Splash screen gives the first imagination and first impression to user about the theme and title of the application before entering the main menu, but the duration will not more than 30 seconds. It is designing in the animation way to make it more interested and attractive to bring the user proceed to main menu page.

There is the skip button provided in the splash screen when user want to reach the main menu quickly by clicking the skip button. The contents of the splash screen are about few pupils are waiting the bus to bring them to the school. They are sitting under the "$" symbol tree which means this application will related to money learning content and it is about the time to start learning when reaching the school.

Due to the splash screen is about a short animation with not more than 30 seconds, a very simple lingo script is added in this module. The bright colours of graphics, sound effect, suitable text is integrated in splash screen.

Figure 4.2.2.1.1 Splash screen I

Figure 4.2.2.1.2 Splash screen II
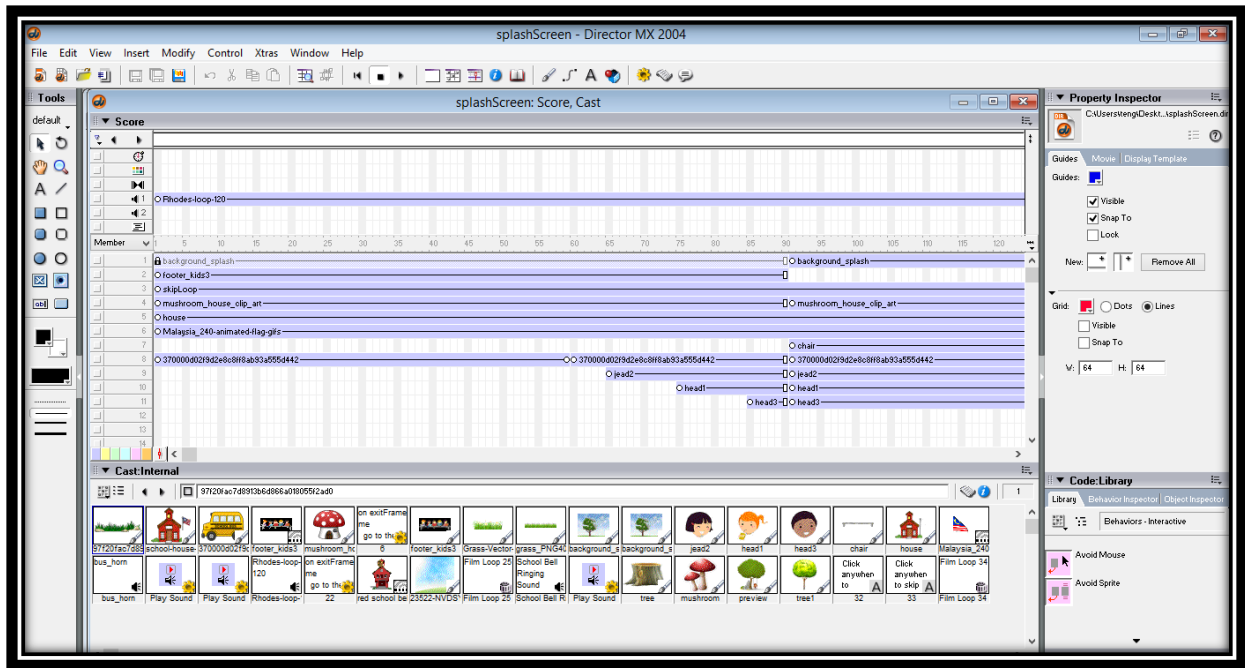
Figure 4.2.2.1.3 Process of integrating the materials and elements in Splash Screeen
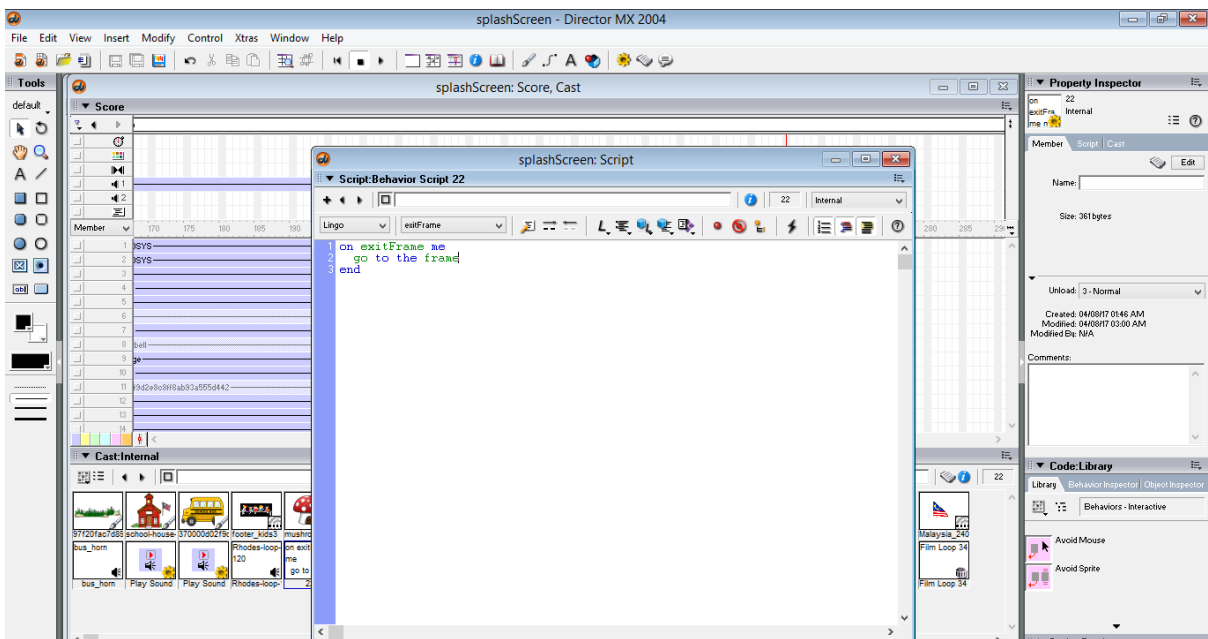
Figure 4.2.2.1.4 Lingo script in splash screen

4.2.2.2 Main Menu module

Main menu is the important page to let user navigates to other modules by clicking the menu button which is represented by the RM100 banknotes. Each banknote can link to different modules which are labelled as Introduction module, Step-by-Step module, Exercise module,

Test module and Game module. The designing of the main menu is simple because simple is more, primary school student may not understand how to control and handle if the menu button is complexity.

The reason of using the banknotes as menu button is because the author wants to deliver the message of good habit of saving money from young to the primary school student. When the banknote is clicked, the banknote will insert to the cup banker and navigate to another module. A vey sunshine background music is available to cheer the student up while using this application. The theme colour of this application is not limit to any colour but bright and suitable colours are using to match the requirement and natural behaviour of primary school student.

A big title is displayed at the top of the application and description of the module will pop out when the user mouse over the banknotes to let user notice and realize the name of the module. Two kids with bags are there to bring the message of this application is suitable for primary school student to use and learn.

A simple lingo script for mouse over function is added to the menu button to pop out the name of the module.
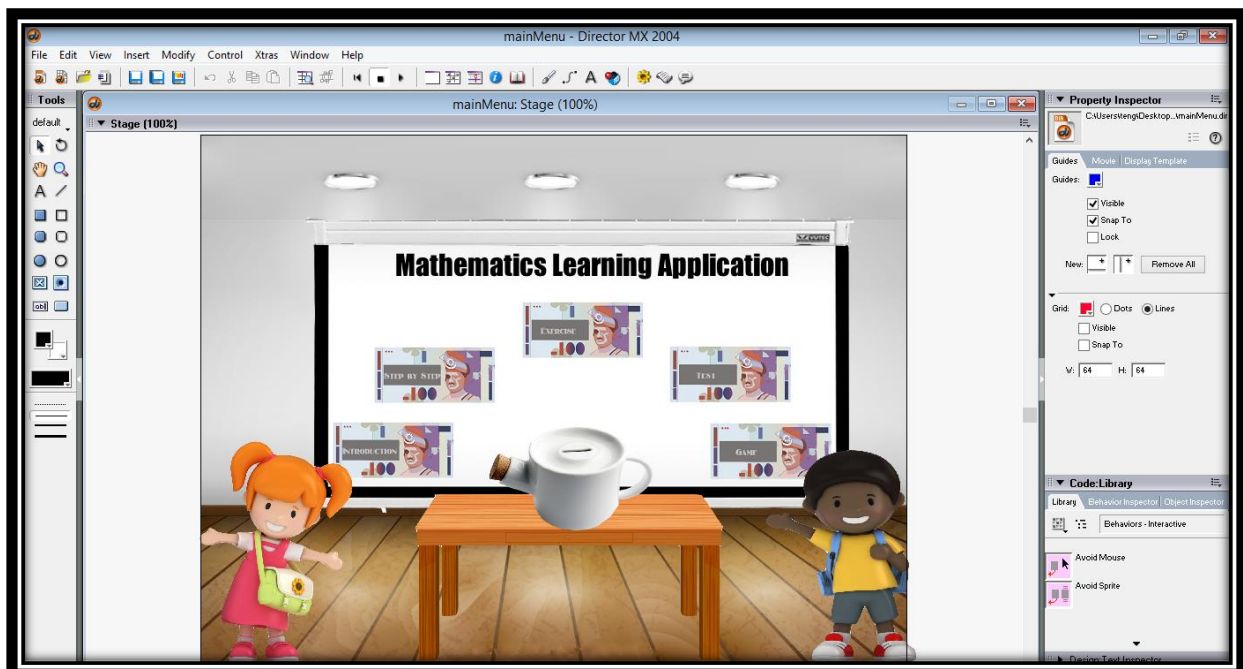
Figure 4.2.2.2.1 Main Menu
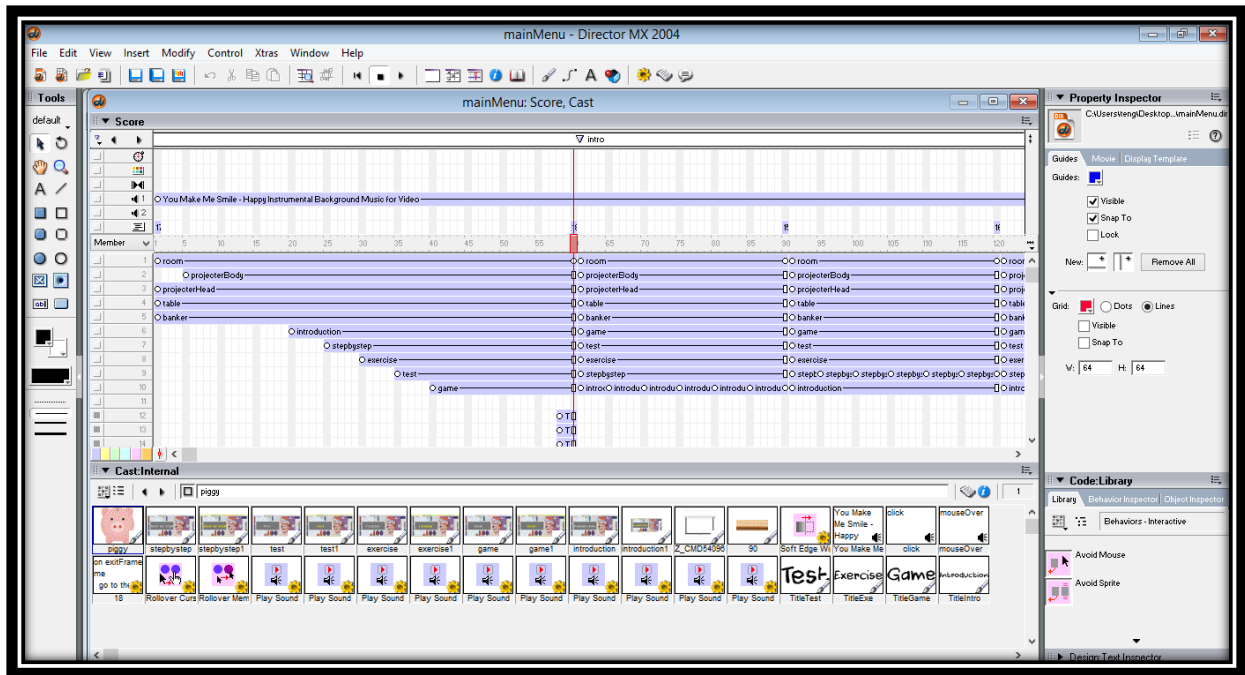
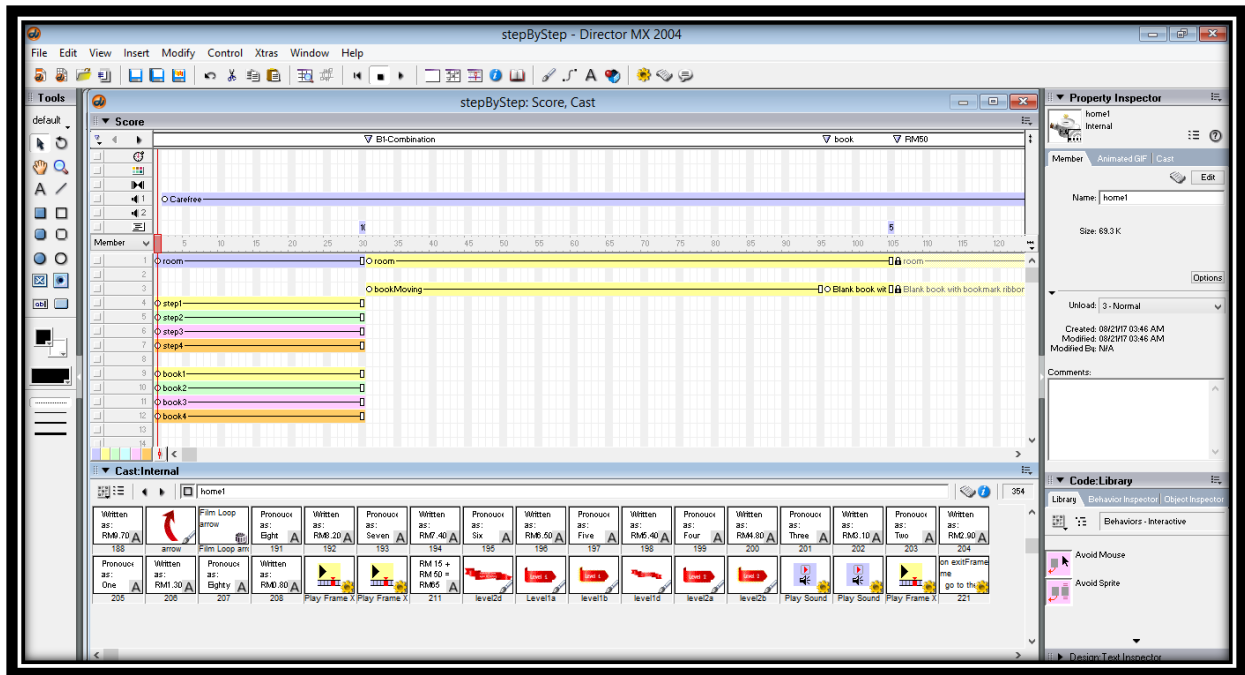*Figure 4.2.2.2.2 Process of integrating the materials and elements in Main Menu*
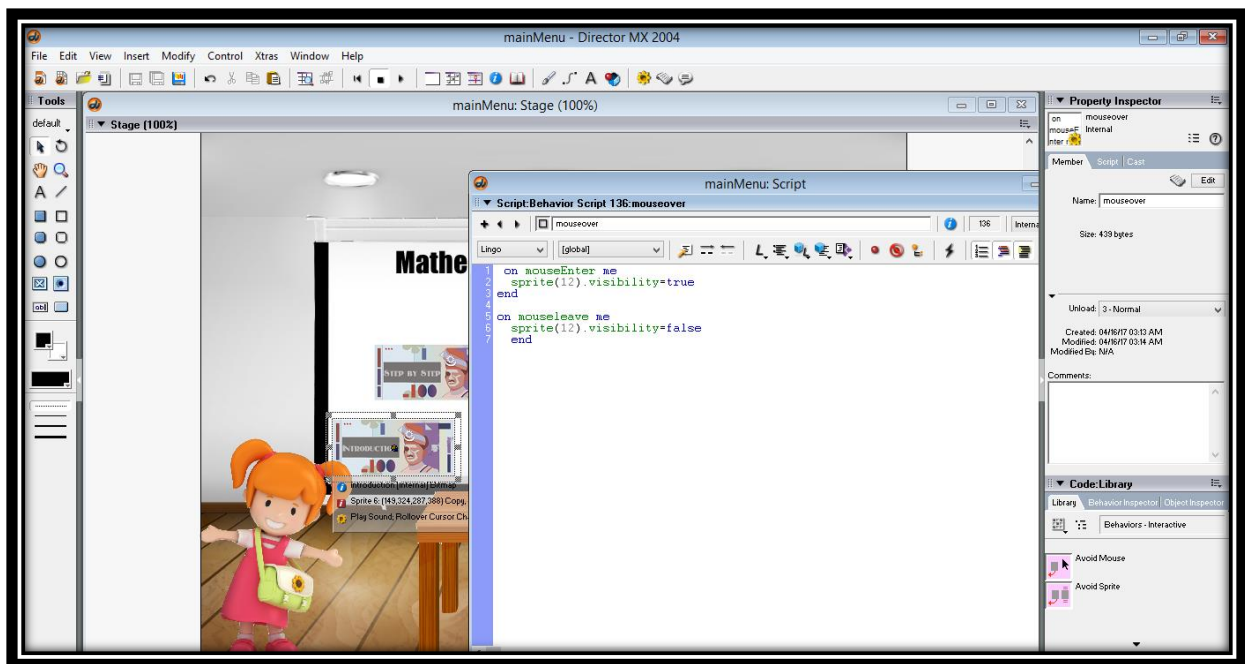
Figure 4.2.2.2.3 Lingo script for mouse over function

4.2.2.3 Introduction Module

Introduction is the basic and foundation module to learn and differentiate the banknotes up to RM 100. All the learning content is taken from the main textbook of the primary school which is the KSSR (Kurikulum Standard Sekolah Rendah). User learns to differentiate the

characteristic of banknotes from the oldest version until the latest version. There are four types of version and user can choose one by one to learn and recognize the banknotes. Mouse Over function is included in every banknote to have a look at the back side of each banknotes.

Home button is provided at the top of the application in order to ease the user to back to main menu quickly by clicking the banker with money moving. There is a bulb blinks to hint the user to take action on the bulb to show some unknown and hidden instruction. Lingo script is need to apply the mouse over function to show hints. Another background music is added in this module for learning mode and bright and colourful theme is applied in this module to attract the attention and interested of user.
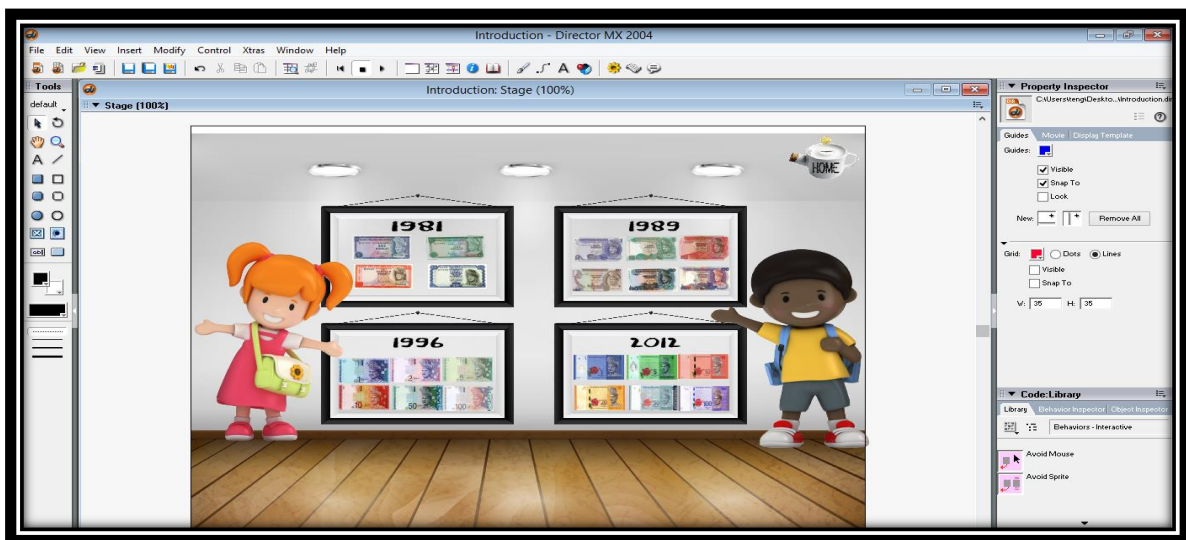
Figure 4.2.2.3.1 Introduction
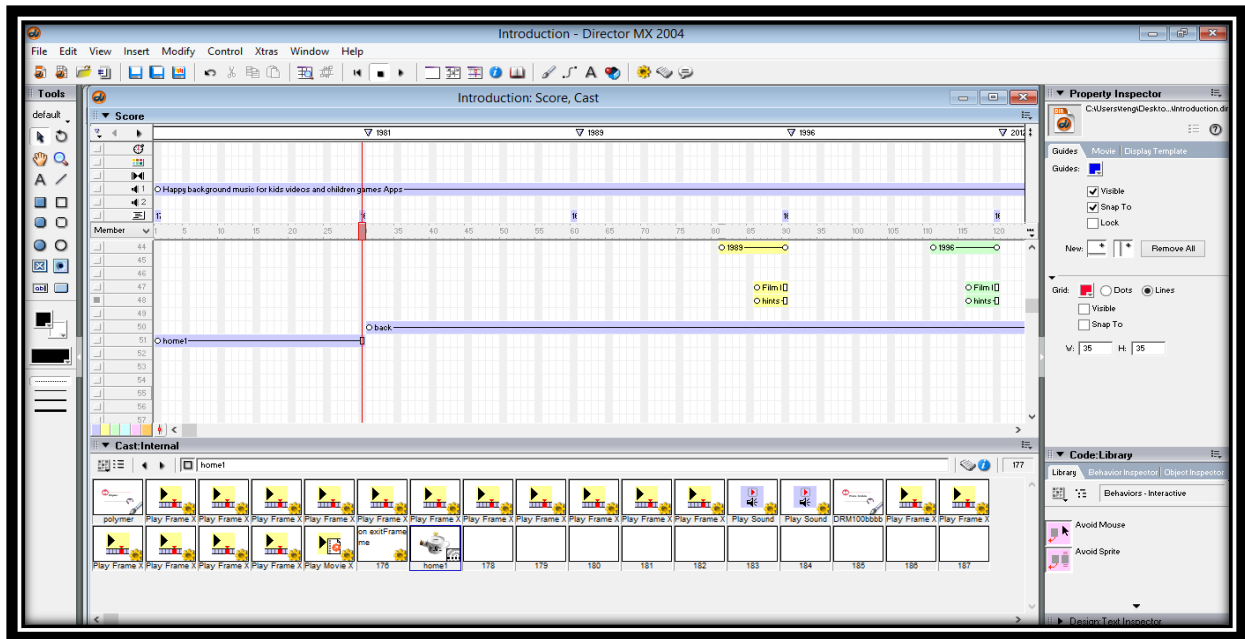
Figure 4.2.2.3.2 Process of integrating the materials and elements in Introduction
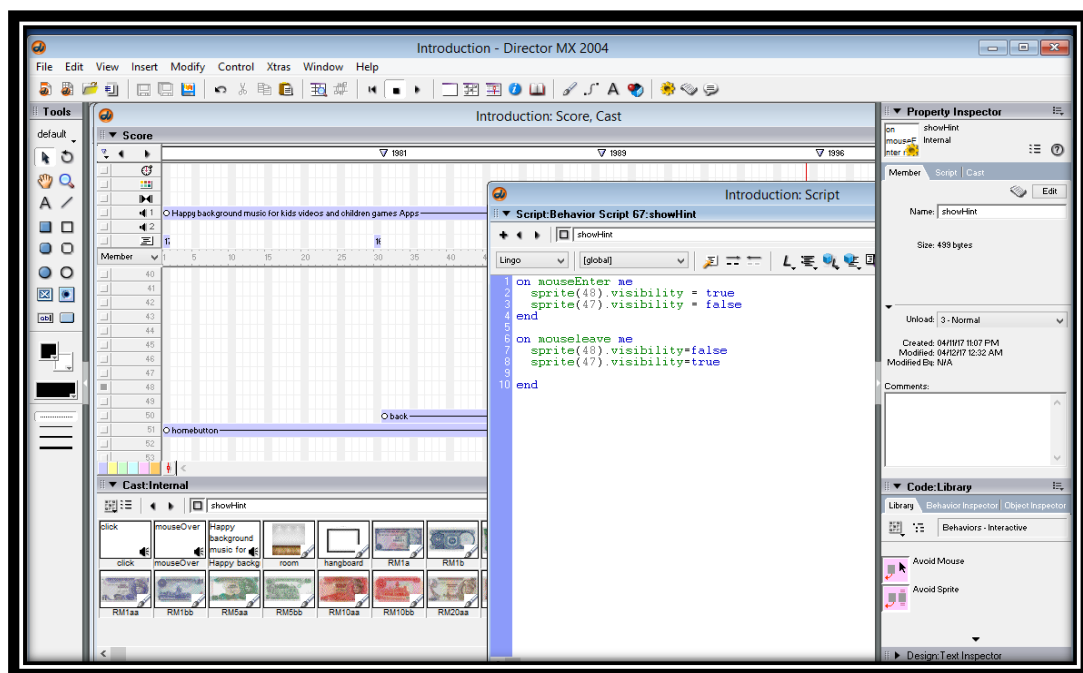
Figure 4.2.2.3.3 Lingo script for the show hints function

4.2.2.4 Step-by-Step module

In this module, the learning process is guided in step by step style. From the lowest stage of the book, start from the easiest until the complex learning content. In the combination stage, it is about the combination of banknotes for the total amount and the other correct combination

of the banknotes is provided also. In addition, equation of the addition is given and the addition will show in the banknotes form to guide the student to know the correct way to add the banknotes. While the subtraction is same process as the addition but it is about deducting the banknotes. The last stage of the step by step is the mathematical word problem which is scenario is asked, and solution is given to solve the scenario.

When user mouse over the books, the description of the book will pop out to show the user the function of the books. Some lingo script is added to apply the mouse over function which leads to another frame to show the description of the book. Another background music is added in this module for learning mode and bright and colourful theme is applied in this module to attract the attention and interested of user.

The reason to design the module by using the books as the stage is because the author wants to deliver the message of the importance of learning the mathematics from the basic and lowest stage then reach to the highest stage. Student have to learn and handle well the basic knowledge before proceed to the next stage because the higher the stage the more difficult of the learning level. Another background music is added in this module for learning mode and bright and colourful theme is applied in this module to attract the attention and interested of user.


Figure 4.2.2.4.1 Step-by-Step

*Figure 4.2.2.4.2 Process of integrating the materials and elements in step-by-step*
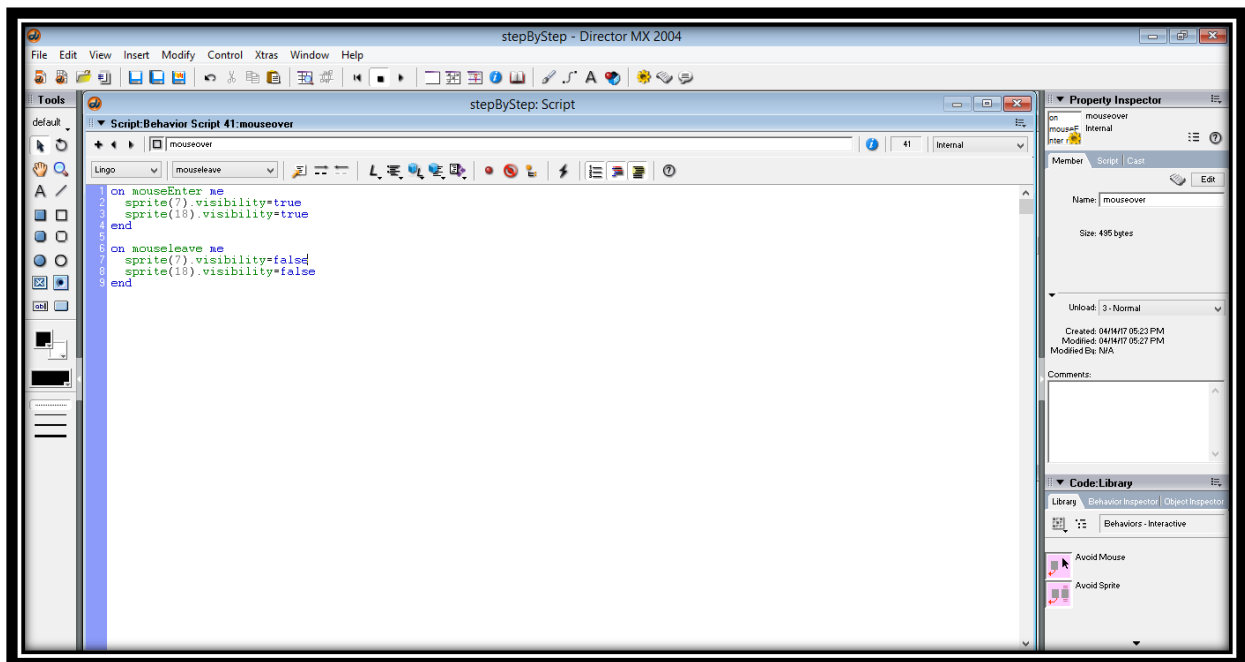
Figure 4.2.2.4.3 Lingo script for the mouse over function to display the description

4.2.2.5 Exercise module

Practice makes perfect, the exercise is provided to strengthen the answer skill of the student.

There are three types of exercise which are from the easiest question to the hardest question.

Narrator is provided to state the explanation clearly. Audio, graphics and text are included in this module to increase the attention of the user while answering the exercise.

Drag and drop function is used in this application to let the user drag the correct item to answer the question. It is to increase the interactivity of user to long lasting their memory while the student is having the hands-on activity. When answering the question, the special sound effect for wrong is appeared when the user clicks the wrong answer and right sound effect is appeared as reward to notify the user when the question is answer correctly.

The purpose of integrate the audio, text and graphics in this module is to increase the absorption and interested of learning in the process of student when the text and audio work together.
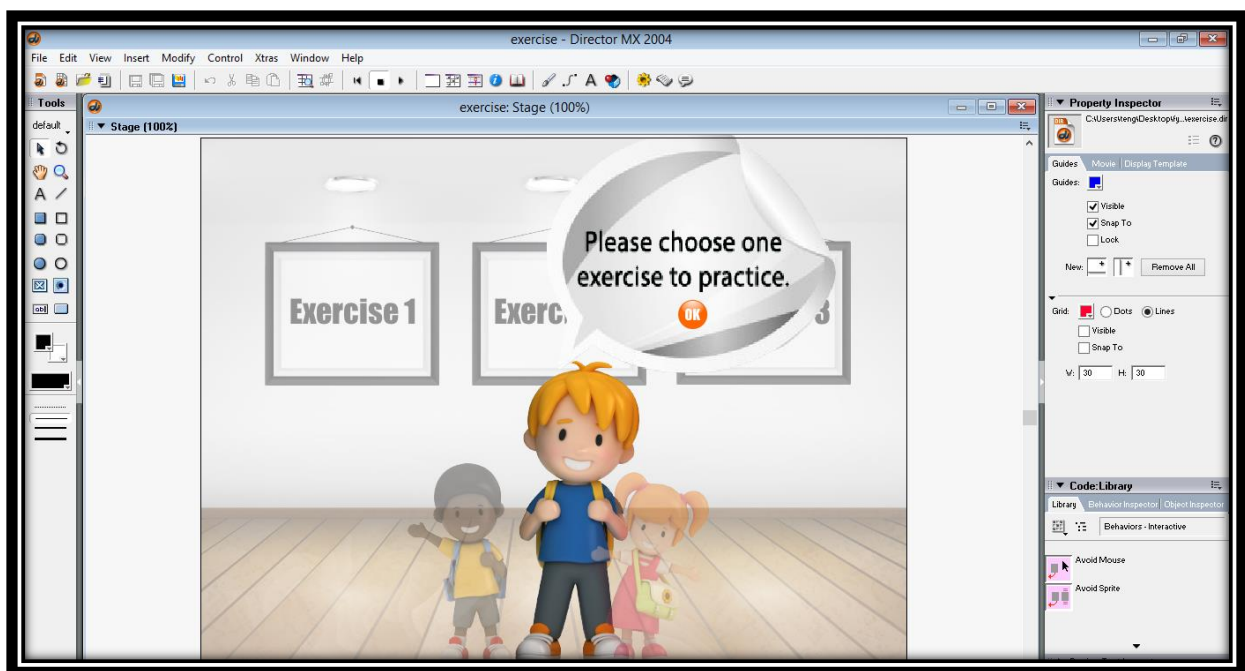
Figure 4.2.2.5.1 Exercise
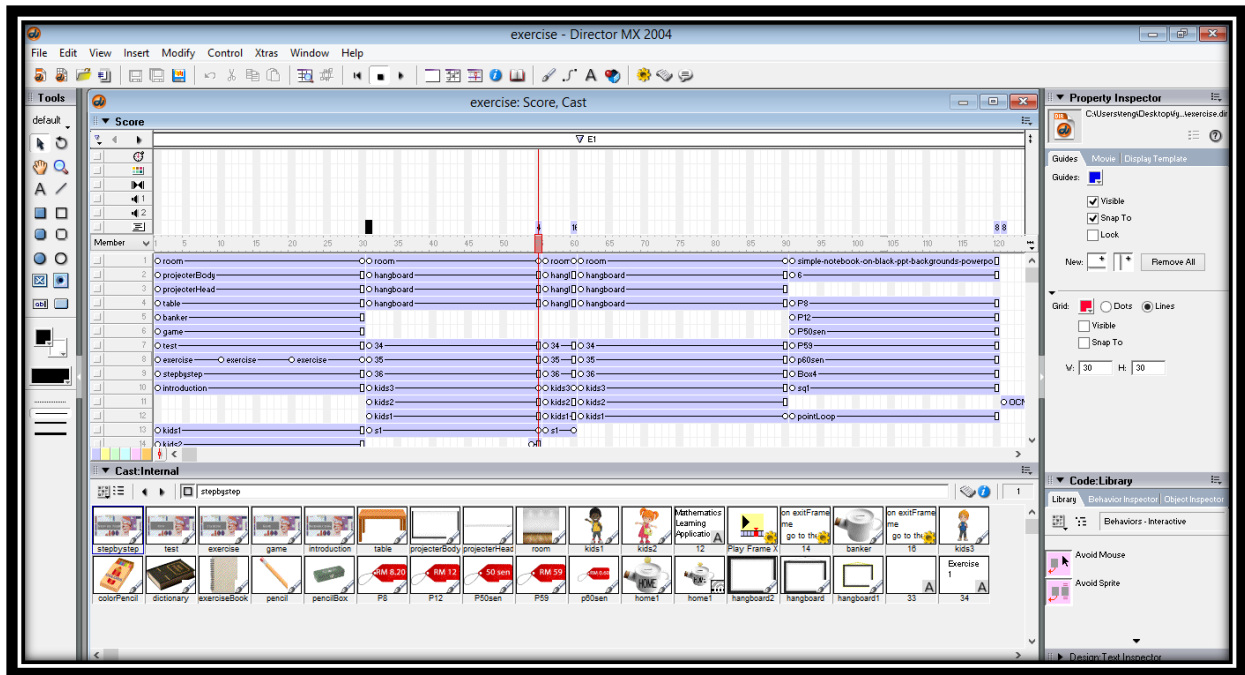
Figure 4.2.2.5.2 Process of integrating the materials and elements in Exercise
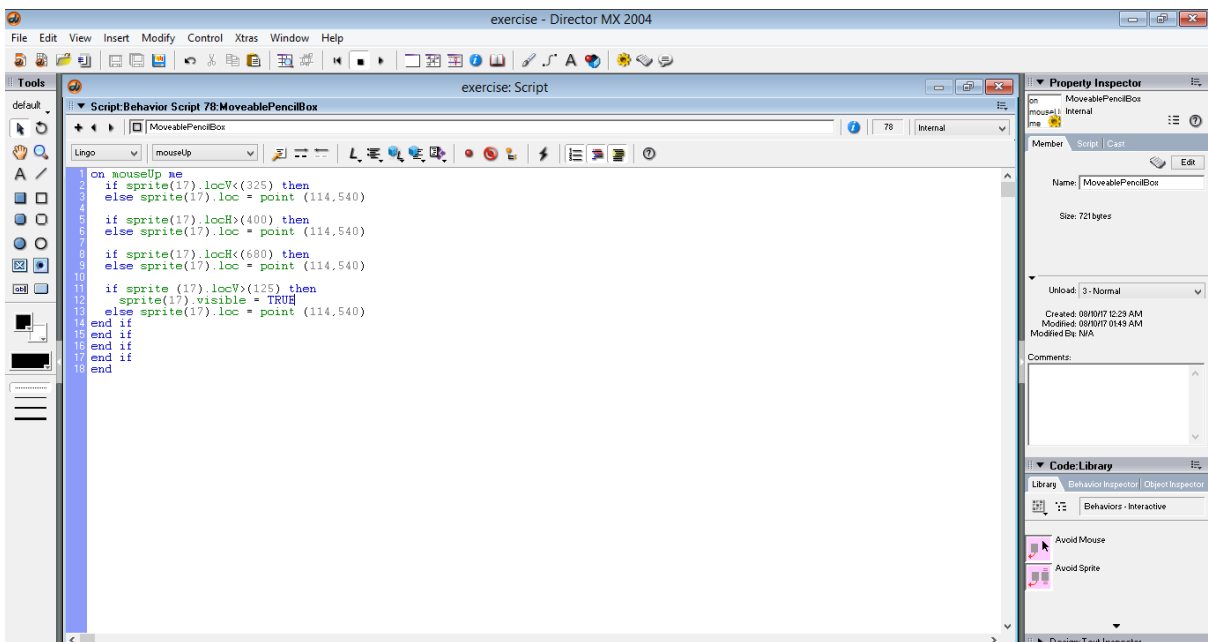
Figure 4.2.2.5.3 Lingo script for drag and drop

4.2.2.6 Test module

The question is set to exam style and user is given time to answer all the question. Scored will be accumulated and show the final score as result at the end of the session.

Graphics and text only are included in this module to increase the focusing of the user while answering the test. Lingo script for accumulating the score will be shown in the figure below.
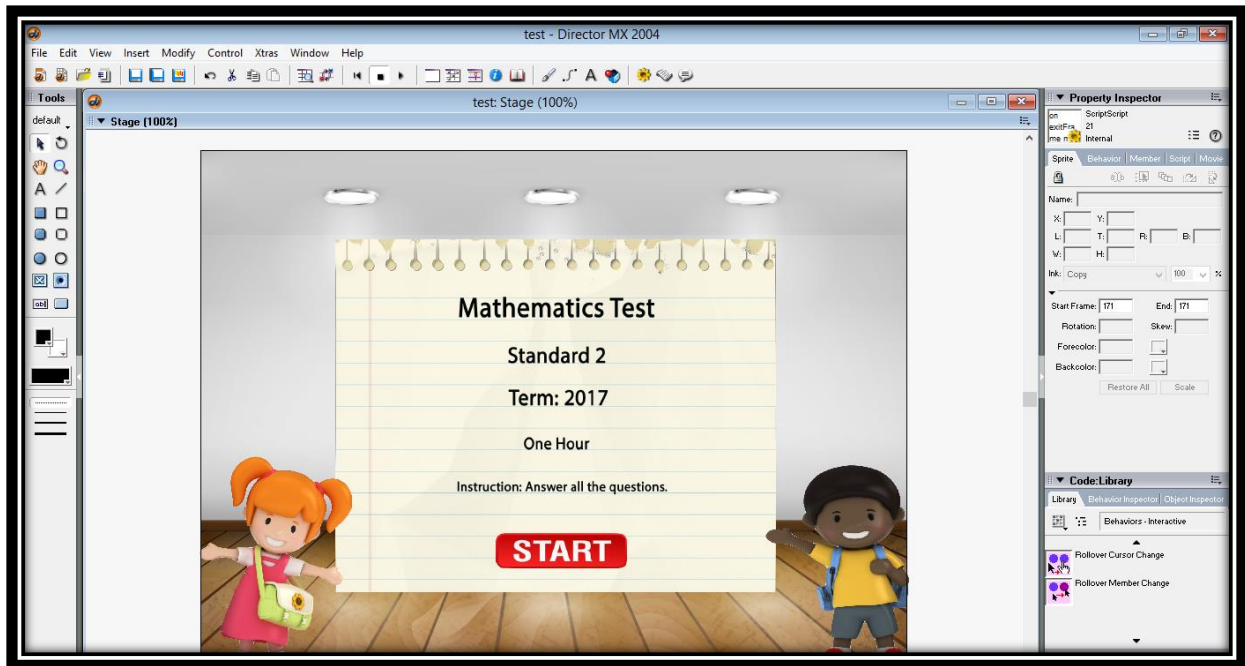
Figure 4.2.2.6.1 Test module
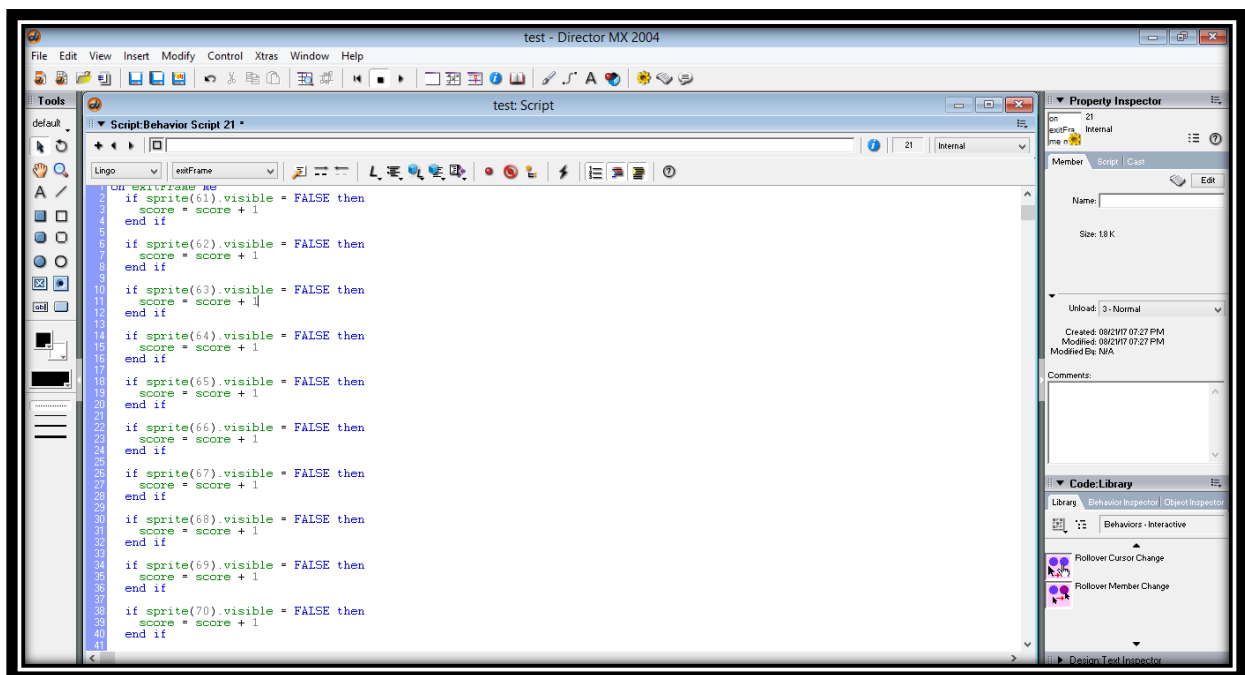
Figure 4.2.2.6.2 Lingo script for accumulation score

4.2.2.7 Game module

Game module is a key module by using the edutainment key activity. User is needed to answer the question correctly and a reward is given until all the question is answered correctly, all the rewards will be given and it will become an animation for user. The rewards are designing in this module because the author wants to motivate the user to answer all the questions correctly and not to give up when the question is not solved.

Audio, animation, graphics and text are included in this module to increase the patience and interested of the user while playing the game. When answering the question, the special sound effect for wrong is appeared when the user clicks the wrong answer and right sound effect is appeared as reward to notify the user when the question is answer correctly. Another background music is added in this module for game mode and bright and colourful theme is applied in this module to attract the attention and interested of user.
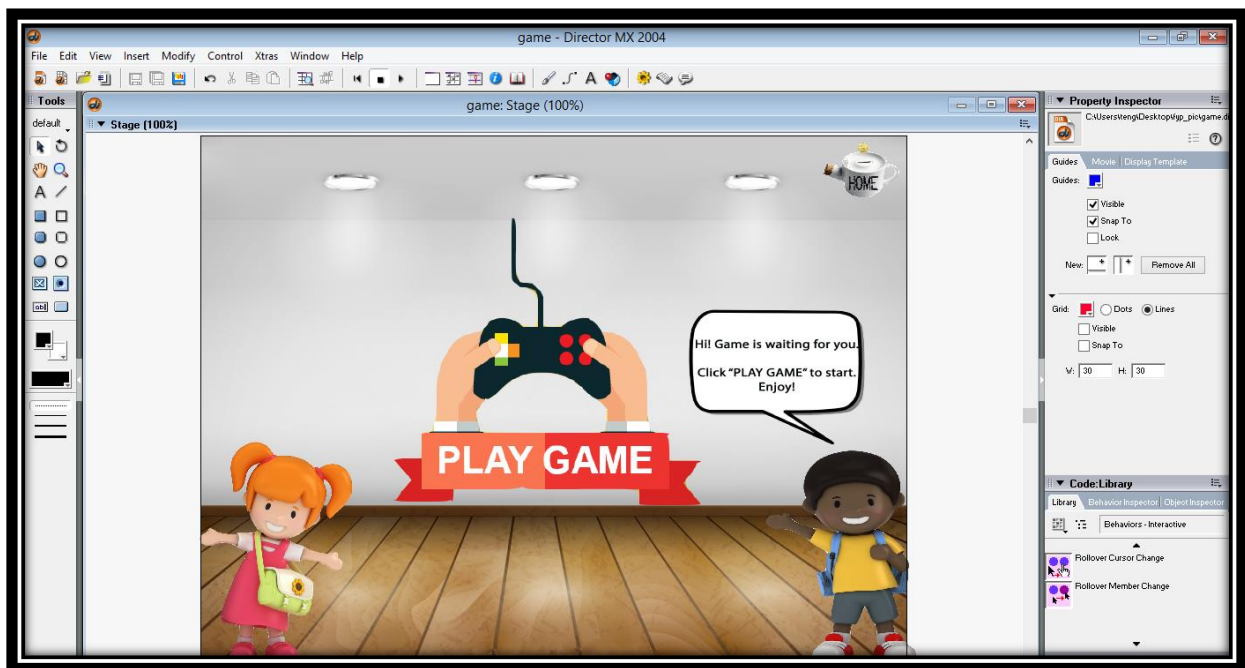
Figure 4.2.2.7.1 Game module
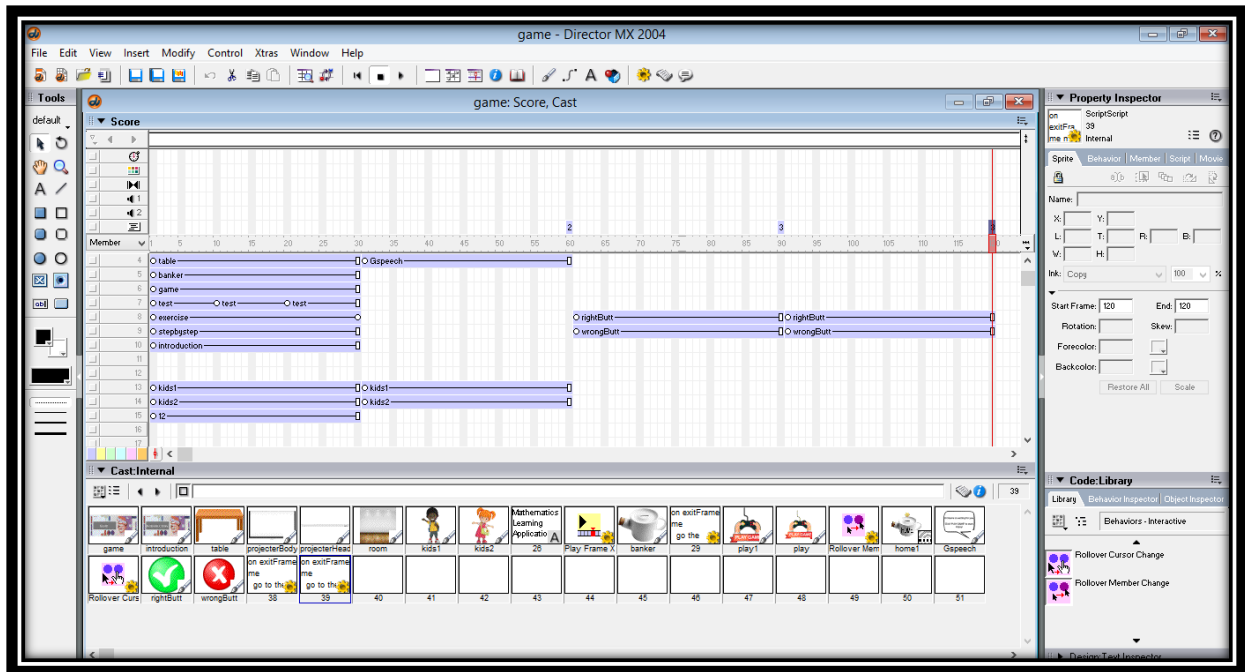
Figure 4.2.2.6.2 Process of integrating the materials and elements in Game
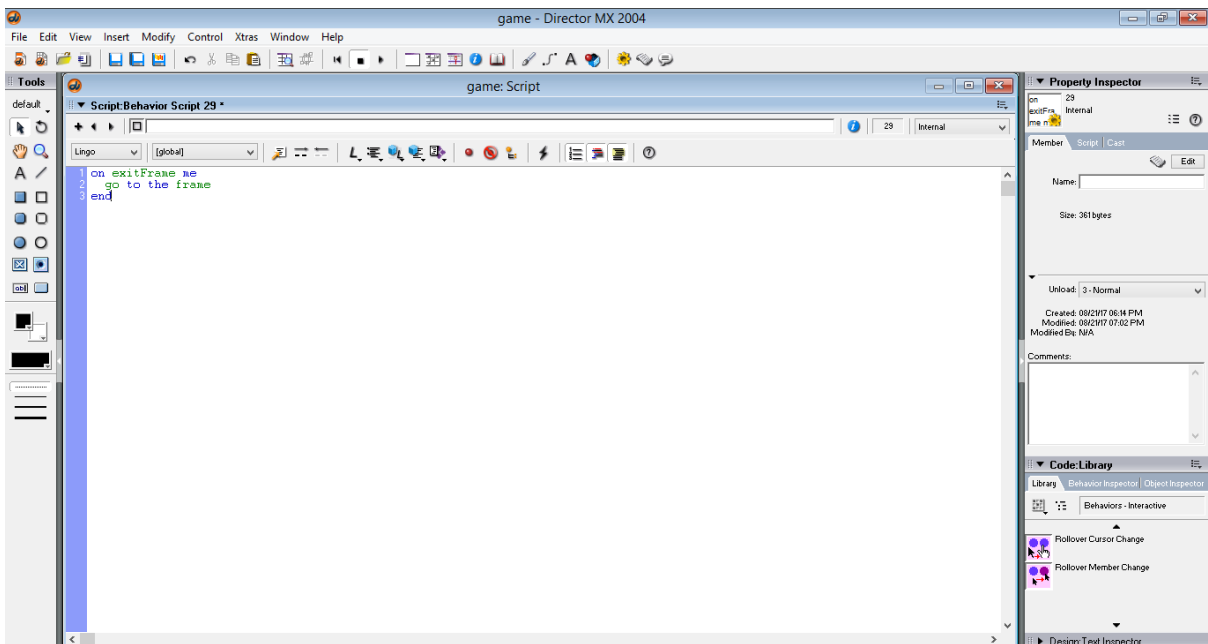
Figure 4.2.2.6.3 Simple Lingo script

4.2.3 Post-Authoring process

After all the modules are done, the author transforms all the works to application form which is exe file format by using the publish function in the Macromedia Director MX 2004, click the "publish" button. The application is presented in offline medium.

Figure 4.2.3.1 Select the publish setting to change the setting
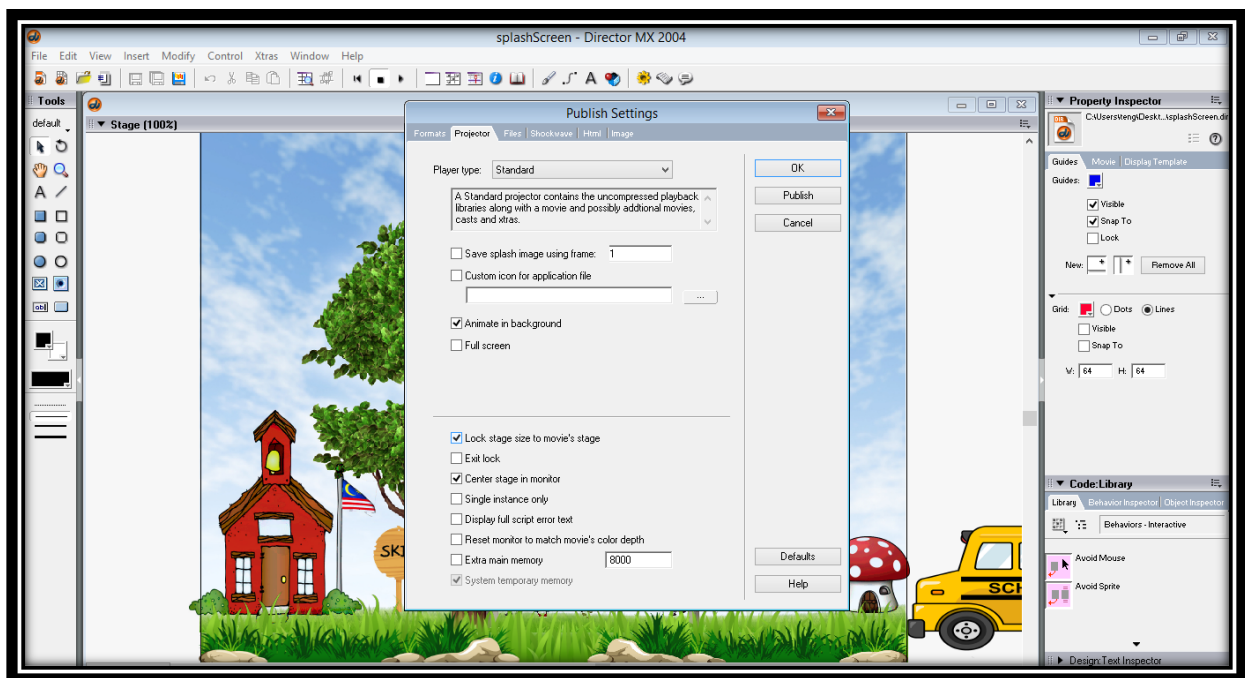
Figure 4.2.3.2 Enable the lock stage size function
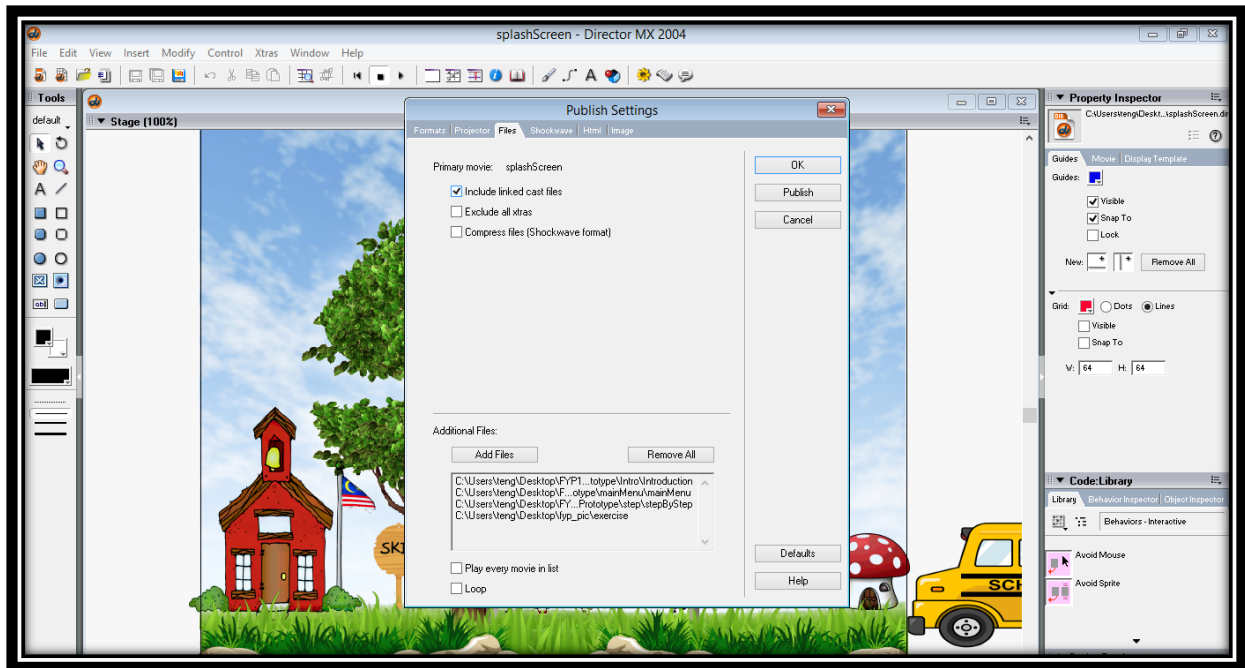
Figure 4.2.3.3 Enable link cast files and add the files
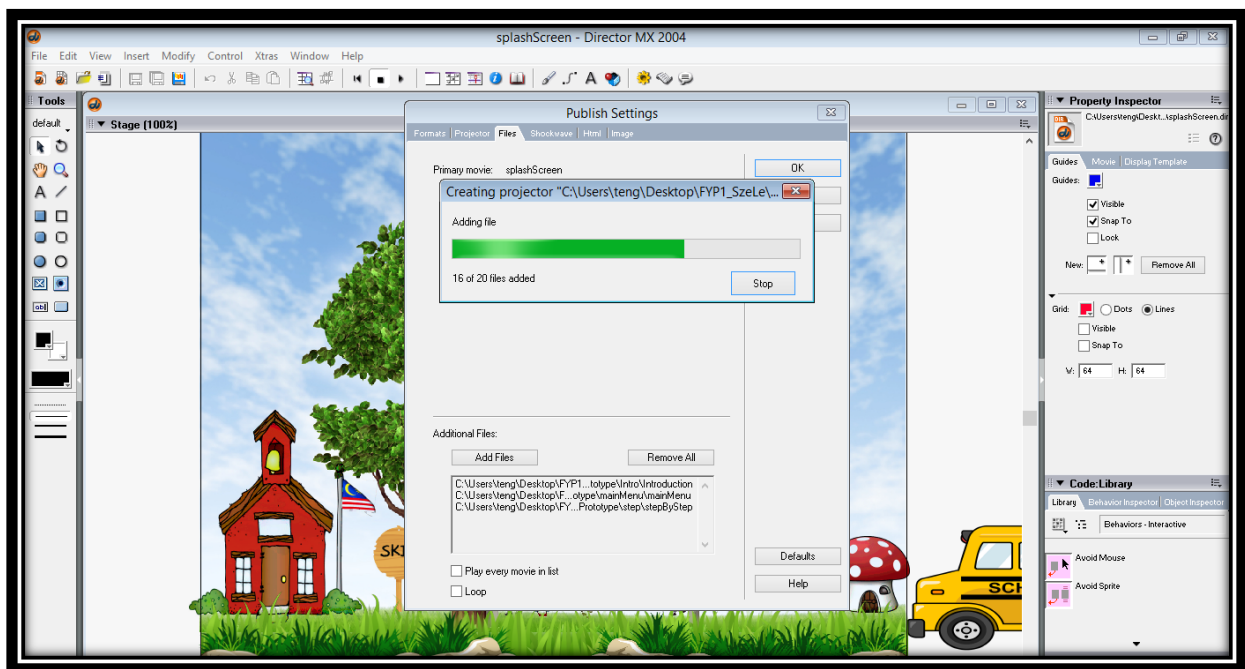
Figure 4.2.3.4 Publishing the files to exe file format

CHAPTER 5 TESTING, RESULT & DISCUSSIONS
5.1 Overview

Testing is very important to execute the program and solve the error if there is any problem or bugs exist in the application. In this chapter, method of testing, testing analysis, result and discussion will be discussed.

For testing part, 30 users from primary school students as target audience have volunteered in participating the testing process and answering the questionnaires. All the modules are tested by the student and to verify and find out the unsatisfied part. Some of students may not fully understand the term of the question in the questionnaires and some of the students are lacking idea while the question is asking to provide suggestion.

5.2 Method of Testing

The method of testing used in this application is to let the users test the complete version of application, fill up feedback and suggestion in the questionnaires that has been prepared by the author.

There are two types of testing is conducted by the author to test the usability of the system which are testing through Google Drive, spread to link to participant and second is face to face communication testing. The application is uploaded to the Google Drive (cloud) and link of questionnaires is provided for participants to download, test and give feedback. Besides, the author meets target audience who are standard two students in nearby area to give guidance on how to use the application and conduct the testing process with the participants.

The result and feedback given is useful for the author to make improvement and enhancement for the application.

5.3 Testing Analysis

The questionnaires are done by 30 respondents from primary school student because the content of the application is closely related to primary school student and the target audience is primary school student also.

The participant is asked for the confidence of using the system, from the result, there are highly percentage of participant feel very confident while using the system and less percentage of

participant feel not confident, it is because some of the primary school student not full understand the term and use of confident.
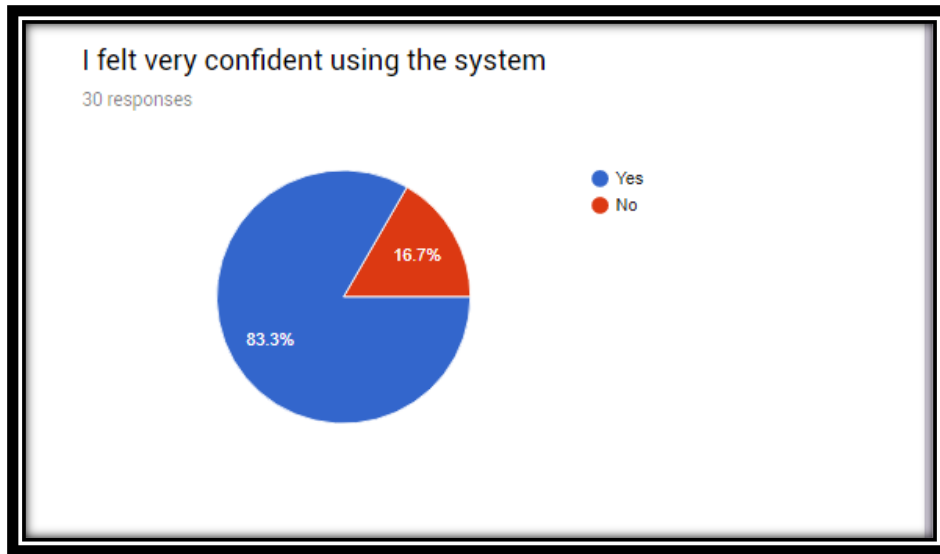
Figure 5.3.1 The confidence of participants

For the second question, participants are asked for the comfortable while using the system, the analysis shows the result is above the average which is very high percentage and less people feel uncomfortable only.
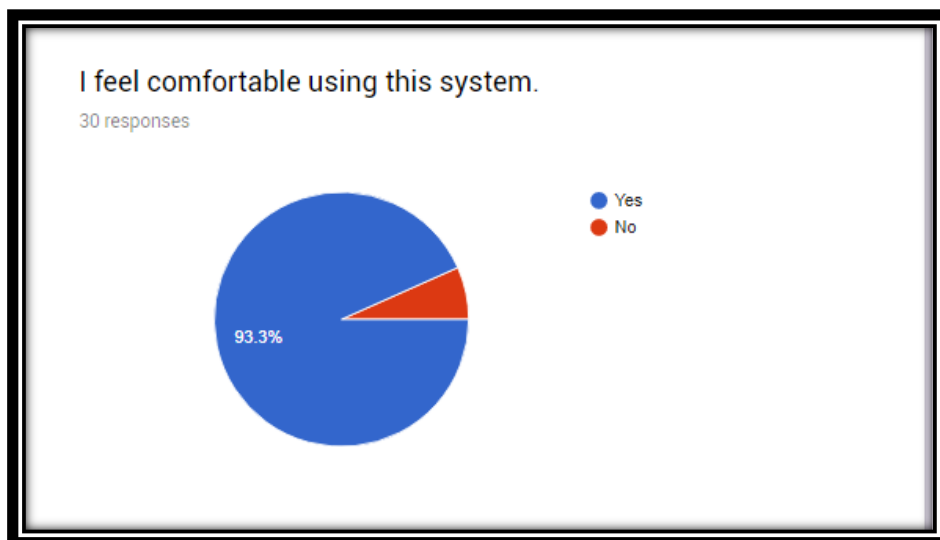
Figure 5.3.2 The comfortable rate of participant

Next, the question is asking about the information provided in the system is easy to understand. Only 10% of participants feel neutral while the other participants feel it is simple and easy to understand which is the percentage is above the average.
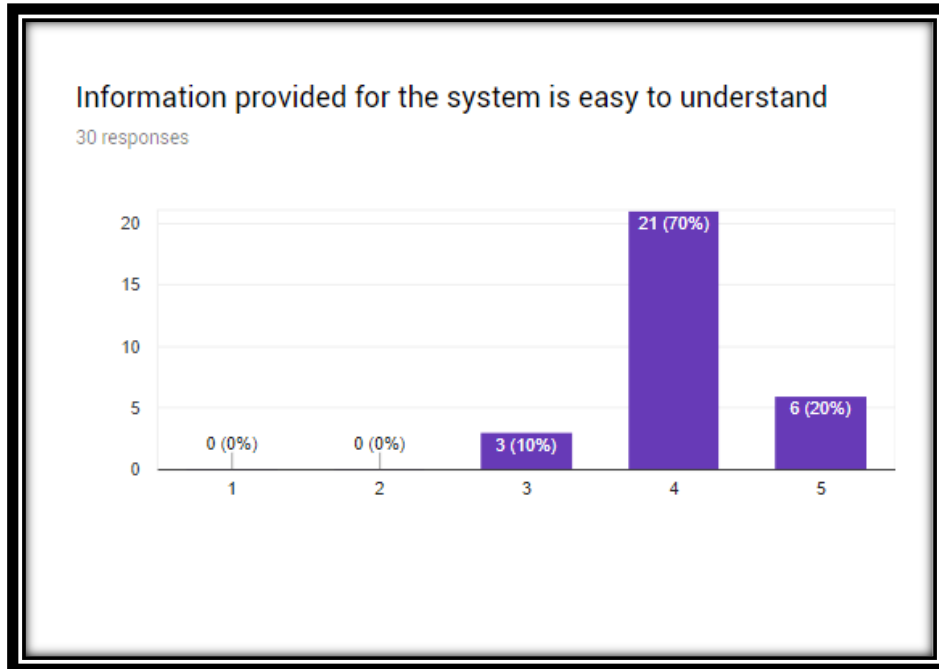
Figure 5.3.3 The easiness of the information provided

The question also asking the appearance of the system interface to know the design of the system whether is pleasant for participants. From the analysis, the result shows that most of the participants agree the interface of the system is pleasant which is above the average and only 20% of participant feel neutral.
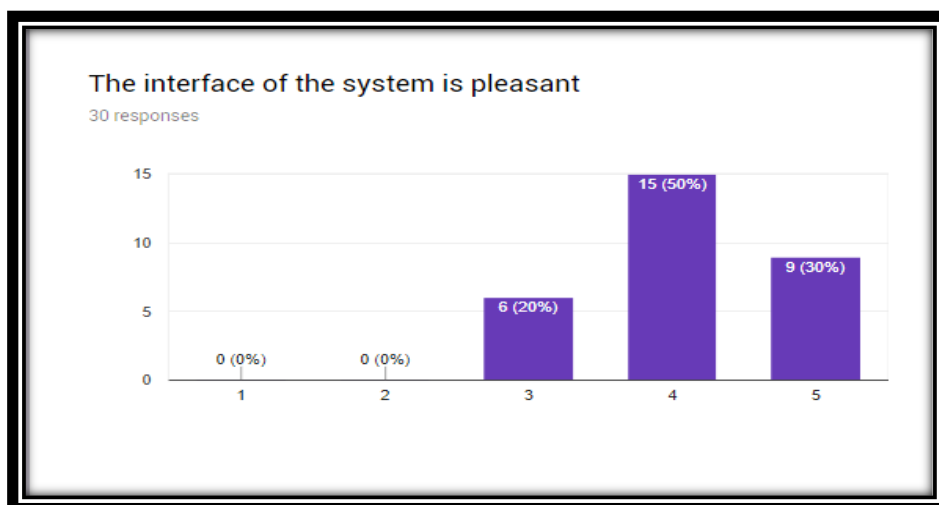
Figure 5.3.4 The rate of interface

The function and capabilities of the system provided also asked in the question to know whether it meets the expectation of the user and participants. Result shows that most of the participants also agree that the function and capabilities meet their expectation while there us 23.3% of participants feel neutral and most of the participants from the 23.3% provide some suggestion to improve the learning process in this system and the suggestion is shown at the following figure.
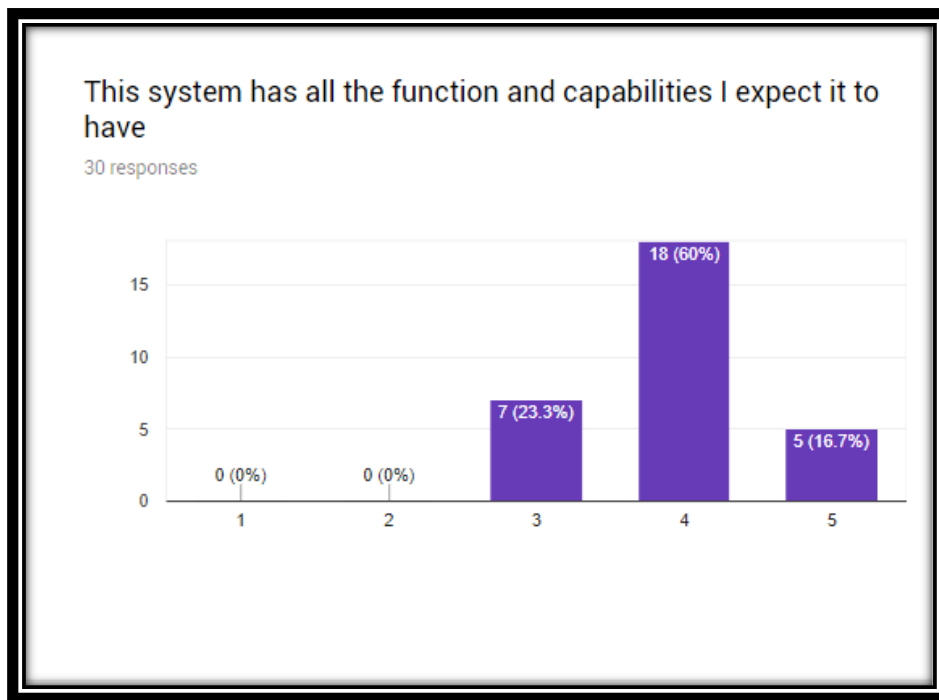
Figure 5.3.5 The satisfaction of the function and capabilities

From the suggestion of the participants, can notice that all the suggestion can be grouped into few categories. Some of the participants have no idea on the improve learning process, some of the participants state that game would increase the learning process, some suggest to provide the abacus while learning because they are weak at using the abacus, some hope that application can be more attractive by adding more colours, character and story while some of the participants are very hardworking so they suggest to provide more exercise, test, extra learning materials, useful tips and formula.
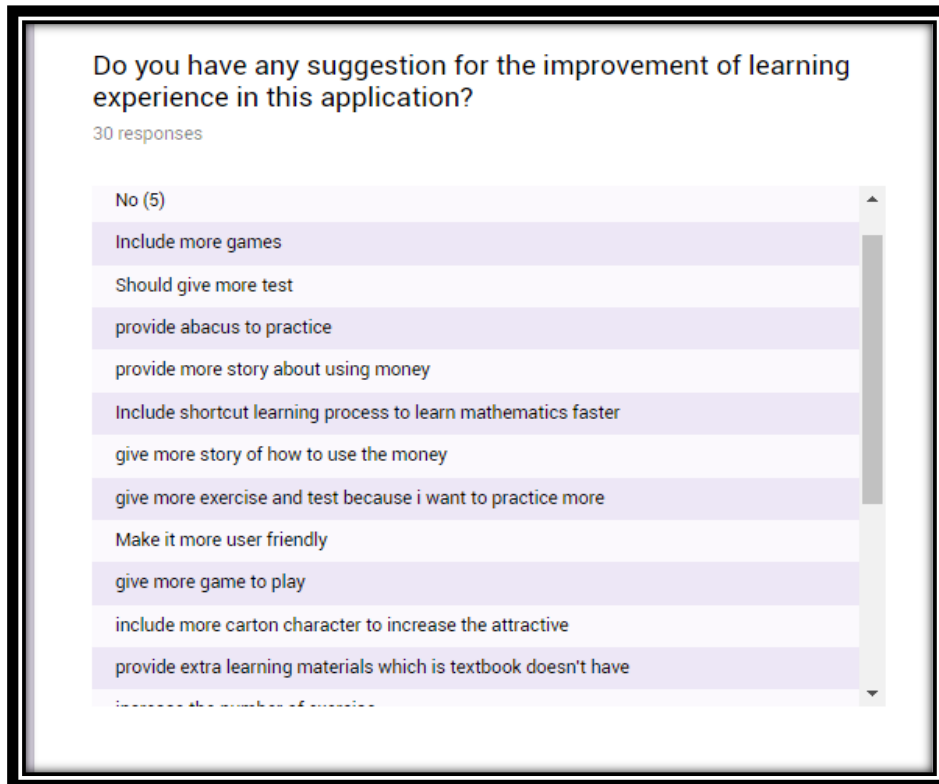
Figure 5.3.6.1 The suggestion from respondent I
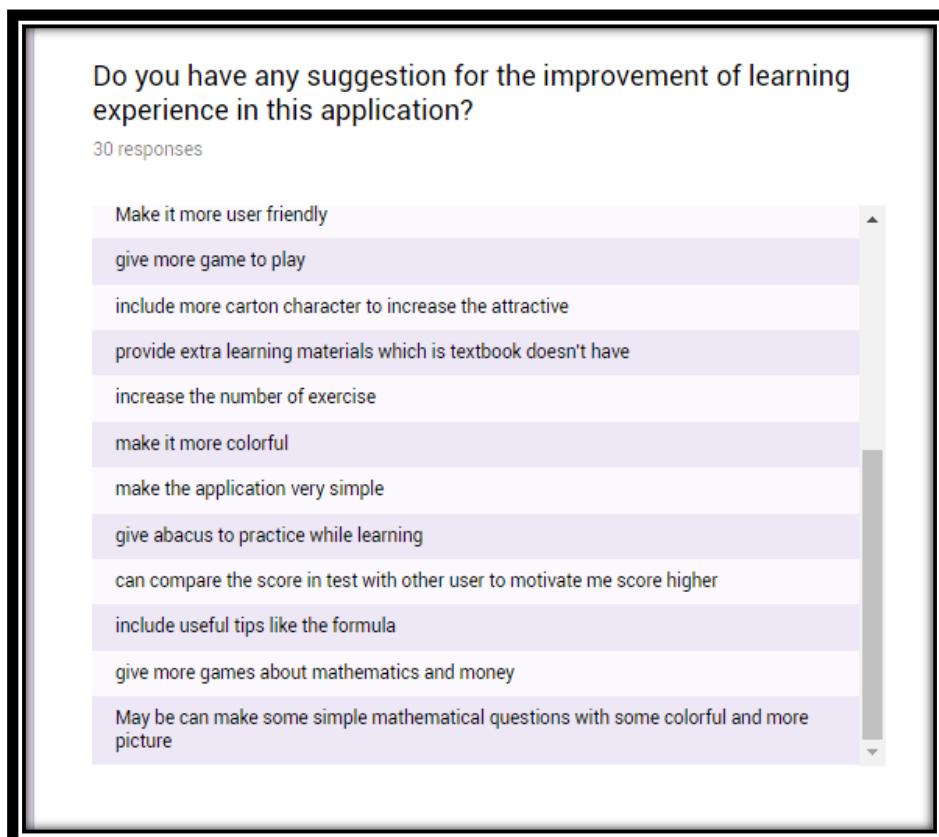
Figure 5.3.6.2 The suggestion from respondent II

For overall, there is only 6.7% of the participants feel neutral for the satisfaction of the system and most of the feel satisfied with this system. The satisfaction is about the whole system which include all the modules and the usability of the system.
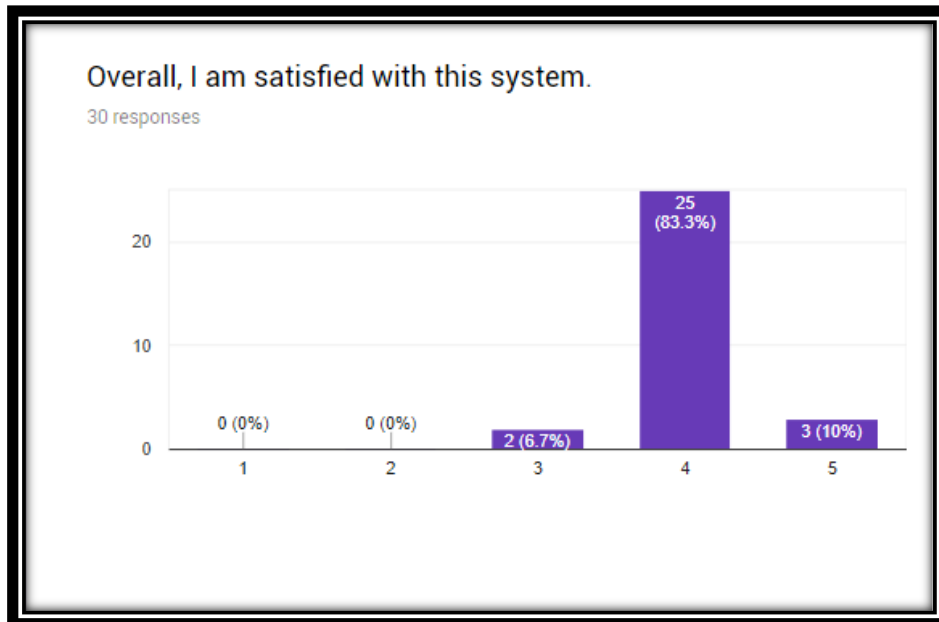
Figure 5.3.7 The satisfaction of system

From the feedback of the participant, there are 70% of participants are willing to recommend this application to their friends or anyone who is suitable to use this application while 30% of participants might want to recommend this application to friend to learn mathematics.

Figure 5.3.7 The rate of recommendation

5.4 Results and Discussions

From the analysis, the author learns and receive a lot of feedback and suggestion from the questionnaires. The author should put herself or himself in the shoes of other, it is because standard two students might not understand some of the word or term so they do not know to answer the question, the author should prepare the question using simple English.

Next, discuss the result of the questionnaires, there are the certain imperfect or unsuitable part which make few of the participants to choose the neutral or no as the answer for the question. First, there are few participants feel uncomfortable while using the application, the colour, speed of narrator or the designing of the learning materials cause the uncomfortable of the participants but most of the them feel pleasant with it and can accept it.

The author can notice that, those participants answer neutral for the satisfaction of function and capabilities means that the function and capabilities do not meet the expectation which they wish to have, and the participants provide the suggestion or features that they wish to include in the application for functionalities and capabilities part to increase their satisfaction.

The suggestion is useful and take into concern because it might present the other primary school student's idea who has no take part in the testing process and answer the questionnaires. However, 70% of respondent are willing to share and recommend this application to their friends and other who needs it and this sharing and recommendation will help the author to hit the objective of this project.

CHAPTER 6 CONCLUSION

6.1 Overview

Until the end of the final year project, the author had come out with the solution to solve to problem statement of the project with some objectives and goals to achieve which is to develop an interactive multimedia Mathematics Learning application for student to solve their encounter problems. Throughout the whole project 1 and 2, the author finally gains sufficient findings on information, user requirement, data analysis, materials for development and others as well to plan well for the project 1 and project 2.

There are a lot of cooperation from the respondent, and guidance from the supervisor help the author to complete and achieve the task in the given period. All of this landing hand had appreciated by the author and without all these helping the author would not make the application success.

6.2 Research Findings

From the research, the author discovers that there is a lot of online multimedia courseware for the mathematics and it helps the student to solve their learning problem. To hit the objective and solve the problem statement of this project as mentioned before, the author has studied and observed how the mathematics in multimedia application can help and solve the problem faced by the student.

The author develops the application based on the needs and problem faced of target audience which is proving in the problem statement. The author tries to include the creativity materials and content to increase the interest and motivation of target audience. Besides, application is delivered in offline and no time limited medium, target audience can use the application and learn based on their attention span. In addition, application is develop using multimedia concept, the author that the multimedia application can solve the ineffective learning method of target audience.

From the result of the survey, most of the respondent agree that the multimedia application can improve the learning process of the mathematics. From the testing survey, the author also knows that there is certain part of the application to be improved to enhance the application such the level of the interactivity, edutainment, user friendly key activities.

6.3 Problems Faced

The problem faced by the author is time management and self-discipline problem. the author fails to manage the time nicely with final year project, study, family time and part time job.

Besides, the author fails to find the material to meet the requirement of the application such as the author want kid voice for the narrator but all those special text to speech voice need subscription, a lot if GIF file is created by the author itself because there are few GIF files available from the internet and the process of creating the GIF file is a time-consuming process.

There is also no main textbook available in the internet so the author faces the problem to get the learning materials but at end the author manage to find the main textbook and buy. Due to the author is weak at coding program, some of the useful function which needs lingo script to run the function takes the author's time to code, test, run and solve the error.

6.4 Knowledge Gained

From the analysis phase until the evaluation phase, the author learns a lot of knowledge and skill to complete this project. At the analysis phase, the author learns to observe and gain the information needed to before starting the design phase because design is based on the requirement, information and target objective. While in designing phase, the author learns the designing skill acknowledge by the natural behaviour of human. A lot of editing and creating materials are gained in order to set the material match with the application's requirement and some of the skill is learnt from the internet such as YouTube tutorial, manual of the software and taught by lecturer. In development stage, the skill in authoring process is taught by lecturer and some of the skill is exploring when the application needs more function.

A lot of formal and standard rules and regulations are implemented in the project which makes the learn a lot and get familiar before entering to the working society that might harder than this project. Without this project, the author may not explore such as great experience which is useful for future.

6.5 Limitations

The resolution of the application is locked and set to a fix resolution size so it cannot be maximized the resolution, it looks bad when the application is maximized. Besides, the content in this application is not enough because the resource to get more content is limited and it might sound less for learner.

The application is delivered in offline medium that CD or softcopy are needed in order to run the application. Thus, targeted audience cannot get the application through online medium such as internet and cloud.

Lack of coding is another main problem for the author in the application. The application can be more attractive and interesting if a lot of functionalities code is implement in this application.

6.6 Future Enhancement

Currently, this project is an offline-based application. In the future development, it could be turned into online-based. With the online capability, the information, learning materials and format could be synchronized and updated from time to time.

Besides, bilingual can be added in the application as new feature because some of the primary schools might not using English as learning language and it is convenience for them to change the language to user's preference.

Database should include in this application to analyse and interpret some useful information from the achievement test of user. It might help to improve the learning process of user and target audience.

Lastly, more games should be included in the future version of the application as suggested by the respondents. This may help them to learn better and gain more fun at the same time.

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Appendix

Sample of Questionnaires

1. Occupation *
   Mark only one oval.

   ◯ Primary school's teacher

   ◯ Course instructor in primary school tuition center

   ◯ Parents of primary school student

   ◯ Primary school student

   ◯ Other: _____

2. Do you agree that primary school students are having difficulty in learning mathematics and apply it in real life? *
   Mark only one oval.

   ◯ Strongly disagree

   ◯ Disagree

   ◯ Neutral

   ◯ Agree

   ◯ Strongly agree

3. In your opinion, what are the reasons that may cause the primary school student having difficulty in learning mathematics? *
   Tick all that apply.

   ☐ Traditional teaching method

   ☐ Shorter attention span of primary student

   ☐ Lack of interest and motivation

   ☐ Lack of effective teaching tools

   ☐ Lack of encouragement from parents or teacher

   ☐ Other: _____

Untitled section

4. Have you heard about multimedia courseware or multimedia application before?
   Mark only one oval.

   ◯ Yes

   ◯ No

5. **In your opinion, which element do you prefer to be included in multimedia application?** *

Tick all that apply.

- [ ] Interactivity of application
- [ ] Good module content
- [ ] User friendly interface design
- [ ] Edutainment
- [ ] Visualization
- [ ] Other: _____

6. **In your opinion, if there is a Mathematics multimedia application designed to improve the learning process of primary student, what do you expect from this multimedia application to help student?** *

_____

_____

_____

_____

_____

7. **In your opinion, which module should be more focused in multimedia application to improve the learning process of Mathematics for primary student ?** *

Mark only one oval.

- ( ) Lesson
- ( ) Exercise
- ( ) Quiz/ exam
- ( ) Games
- ( ) Other: _____

8. **How do you want this multimedia application to be delivered?** *

Mark only one oval.

- ( ) Offline medium (Can be downloaded)
- ( ) Online medium (Can only be access when Internet is available)
- ( ) Cloud medium (Can be access anywhere and save your progress)

9. **Would you recommend your primary school student/ children/ friend to use this multimedia application in learning Mathematics?** *

Mark only one oval.

- ( ) Yes
- ( ) No
- ( ) Maybe

1. I felt very confident using the system *

Mark only one oval.

( ) Yes

( ) No

2. I feel comfortable using this system. *

Mark only one oval.

( ) Yes

( ) No

3. Information provided for the system is easy to understand *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	( )	( )	( )	( )	( )	Strongly Agree

4. The interface of the system is pleasant *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	( )	( )	( )	( )	( )	Strong Agree

5. This system has all the function and capabilities I expect it to have *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	( )	( )	( )	( )	( )	Strongly Agree

6. Do you have any suggestion for the improvement of learning experience in this
application? *

_____

_____

_____

_____

_____

7. Overall, I am satisfied with this system. *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. Would you recommend your friend to use this application in learning about mathematics?
*
Mark only one oval.

◯ Yes

◯ No

◯ Maybe

Plagiarism Check Summary

Project Content

Weekly Report

Form iad-FM-IAD-005

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Teng Sze Le
ID Number(s)	13ACB05301
Programme / Course	BIS (HONS) Business Information Systems
Title of Final Year Project	Computer Aided Instructions (CAI) Mathematics Using Learner Centered Approach

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
Overall similarity index: _____ % **Similarity by source** Internet Sources: _____% Publications:_____ % Student Papers:_____ %	
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Parameters of originality required and limits approved by UTAR are as Follows:
  (i)   **Overall similarity index is 20% and below, and**
  (ii) **Matching of individual sources listed must be less than 3% each, and**
  (iii) **Matching texts in continuous block must not exceed 8 words**
Note: Parameters (i) – (ii) shall exclude quotes, bibliography and text matches which are less than 8 words.

Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

_____   _____
  Signature of Supervisor   Signature of Co-Supervisor

  Name: _____   Name: _____

  Date: _____   Date: _____

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Faculty of Information and Communication Technology (Perak Campus), UTAR.   J