Mobile MathTactics - Mathematics Game Based Learning

by

MohdZulothman Mustapha 12038

Dissertation submitted in partial fulfillment of
the requirement for the
Bachelor of Technology (Hons)
(Information & Communication Technology)

SEPTEMBER 2012

UniversitiTeknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

Mobile MathTactics - Mathematics Game Based Learning

by

MohdZulothman Mustapha 12038

A project dissertation submitted to the
INFORMATION AND COMMUNICATION TECHNOLOGY PROGRAMME
Universiti Teknologi Petronas
in partial fulfillment of the requirement for the
Bachelor of Technology (Hons)
(Information & Communication Technology)

SEPTEMBER 2012

Approved by,

_____

(DR WAN FATIMAH WAN AHMAD)

Associate Professor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

September 2012

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

……………………………………………………………….
MOHD ZULOTHMAN BIN MUSTAPHA

Abstract

Mobile MathTactics is a mobile game-based application inspired to teach children on the subject of mathematics. Mathematics is a very interesting field as it can explain many of evidence to us through calculations and numbers. However, because it is too complex for a normal person to understand it, especially young kids, mathematics might draw "sour grapes" on their faces. Apart from that, the inefficient teachings models adopted by the academic educators have also worsened the case to even severe that what it already is. Lack of narration and meaning behind those numbers frightened people away from learning mathematics. Therefore to counter the problems, the author has come up with the idea of using games as the learning tool to capture the interest of small children. Games, for centuries (since the beginning of personal computer era) have renowned for its enjoyable and fun environment. Thus, by applying the same concept to the subject mathematics, the education industry can improves itself through a whole new teaching method. Moreover, it uses English language as the medium of interaction with the user apart leveraging the mobile technology as its core platform. The application focuses on three mathematical modules, which are addition, subtraction and lastly multiplication. The whole project is done with Rapid Application Development methodology, as it is much flexible and suitable for the short duration of development. After developed the simulator of the application, the prototype was tested with ten students. The final conclusion is that Mobile MathTactics is able to meet its objectives although improvements are still needed for better future commercial option.

Acknowledgement

First of all, the author would like praise to Allah S.W.T, the Most Gracious and Most Merciful for giving the opportunity and strength in completing this project dissertation without extreme difficulties. In this opportunity, the author would like to express gratitude to her supportive supervisor, Assoc. Prof. Dr. Wan Fatimah Binti Wan Ahmad for her kind assistance and guidance while developing the project.

The author would also like thank her colleagues in Universiti Teknologi PETRONAS (UTP) for their constructive feedback that contributed in the process of developing the project. Not to forget, greatest gratitude goes to his beloved parents, Melia binti Mus for her endless support and motivation.

Lastly, the author would like to express his gratitude to his friends and those who help directly and behind the scene in the duration of completing the Final Year Project.

Table of Content

List of Figures

List of Tables and Graph

CHAPTER 1

INTRODUCTION

1.1 Background of study

Recent years have been a booming era in the advancement of information technology. It aids so much in making our everyday life much easier in various aspects, especially in the education industry. A section that which IT could really revolutionize teaching is through mobile learning. Twenty years ago, mobile learning might not have been seem possible, as there is absent of tools back then to leverage the learning model. Despite that, a little whilst back IT has proven that mobile learning can be implemented with the aid of advancement in mobile platform.

Apart from that, information technologies able to relieve the problem in familiarizing with subjects, like mathematics. Most people consider the learning of mathematics is difficult, dull and does not engaging the students. It is so hard to be understood, because of its complexity of the subject, which many times that people failed to see the links between them, thus it becomes meaningless.

Therefore, by means of the mobile learning application like a mobile game-based app that combines the subject of interest (like in this project, mathematics) with some artistic values, the schooling of any subjects are now flipped over into a whole new way to gain attention and attracting the student's interest.

1.2 Problem Statement

Simple word - Math is boring and complex. To most people, it would easily gives one headache if the person unable to understand the basic numbers and operations as

it could induces stress and might not seem to have any use in daily life, which happened to be opposite of the fact. Numbers are everywhere, and it is all around us.

Following are identified causes faced by the teachers and the students:

a)   **Boring and complex**

One cannot get away from the fact that math is complex and too structural. As deeper one got into math, the complexity such as too many theorems, will added and builds up walls in front of the relations and rational behind the numbers and many times that people unable to get the connections between them, thus becomes meaningless. This hinders any further understanding on math and eventually bores the students quickly more than anything else. The reason behind it is mathematics pushes the brain to think harder in solving a problem. Learners are also presented with the a lot tables and formulae which have to be remembered. Thus, students are forced, with no option to memorize some of the given tables and formulae rather than making use of its application.

b)   **Ineffective method of teaching**

Mathematicians, especially academic educators are so used to the static-structural ways to educate students on math, and sometimes especially to those who are not directly involved in the field. A simple example can help painting the whole picture. Take most of the academic (like mathematic) research papers, for some reasons, eschewing the use of narrative technique to retain the reader's interest. One can easily conclude, these papers are mainly to "providing the facts" instead of putting the humanities in mind, or in other word, to "entertain."

The teaching is also lack of narration or flow to connect the "dots" between the "gaps" in relating a chapter to the next in its teaching style. Due to the explanation above, it does not engages more than interacting to the learner, which in the end resulting an upset learning environment, or called, "dryness" in teaching.

1.3 Significant of Project

The project is able to help in working out the problems mentioned earlier. For example, it can aid in:

i) Changing the dullness in schooling of math into much fun, engaging and interactive productive sessions

ii) Simplifying the complexity in math with organized flows – like students can chooses the mathematical operations that they wish to work on with structured difficulty levels

iii) Portable learning with no restrictions on studying and practicing math (like time, space, etc.)

1.4 Objectives

On the discussion earlier, this project is expected to describe, addressed and tackled each difficulty in which the education of math has faced, that is to use technology, such as mobile technology to help in revamping the traditional teaching model into much fun, engaging and very portable.

Below are some of the goals that are desired to be achieved:

i. To make a research on a suitable leaning model for teaching and learning (for example the subject mathematics)

ii. To develop the prototype of the application

iii. To evaluate the user satisfaction on the product in terms of overall application satisfaction, performance of the application, difficulty in answering the quiz questions, challenges in completing the mission and the successful in answering the quiz problems.

1.5 Scope of Study

From these goals above, the project would satisfy:

• Targeted demography of children aged 9-10 years old (primary 3 and 4 students)
• Learning mathematics using English language

• Focusing on certain mathematical modules - mathematical operations (addition, subtraction and multiplication)

• Type of technology - mobile technology

• Use a puzzle video game (action puzzle or arcade quiz game) genre of the mobile application

1.6 Relevancy of the Project

Mobile MathTactics provides a lot of benefits to its users, because it uses the mobile technology to deliver its potential on transforming the way education is presented to the younger generations. With this application, the subject mathematics can now be taught with much fun and exiting style and is able to break-through the "traditional method" of teaching. Apart from that, it can help the students to be more engaging in class as well as providing an option to them to reach the learning even outside of the walls of the classroom.

CHAPTER 2

LITERATURE REVIEW

2.1 Mathematics: the killing-boring subject

According to Baez J.C (2007), he explicitly pointed out the one of flaws in mathematics, which was the prominent of long and complicated factual and theoretical contents rather than connecting the usage and examples of real life application regards to the matter or certain topics discussed. It was presented in a manner with less interaction, full of texts-based theories and infinite numbers and symbols with giving out the reasons behind or usage of those numbers. Besides, John also mentioned the complexity existed in mathematics whom most of the mathematicians could not strip it down to its most simplicity.

"...However, the author does not expend much energy to make this clear." - Baez J.C (2007). This quotes clearly shows that academic educators, or more specifically to those mathematicians, are unable to clarify the "twists" or hidden meaning with further explanations in the subject, which only focuses on proving the founded theorems.

Not only that, John also gone in mile length about the static-structural way of tutoring the subject mathematics. He stated that the absent of narrative style is also one of the reasons which makes mathematics difficult to be understood by most people, mainly to those who are not directly involve in the expertise or generally, the field. And because of this, Kislenko K., Grevholm B., and Lepik M. (n.d.) has laid down the same issue that imparts basic impact on student that is lack of narration and elaborations on the applications of math which leads to the demotivation in learning the subject.

2.2 Mobile learning: learn everywhere and anytime

What really defines mobile learning according to Geddes S.J (2004) is the accessible in getting the resources and information that enables the learning to be portable.

This is because as he reported, people are constantly in need of faster and the ability to retrieve the resources anywhere and anytime as this matter is highly affecting their everyday life – such as businesses updates, social communication, news and education.

This can only be done through mobile technology, and specifically to education – the mobile learning. It removes the space and time constrains that gives the user flexibility and freedom. In addition, because of this, mobile learning promotes collaborations among the users, which awards huge benefits in any aspects and future use – for example, sharing of latest information.

2.3 Mobile game: The crisp surprise of education

Mobile game has really gained its attention recently, which resulted from the booming in the mobile technology line. These mobile technologies are not restricted to only mobile smartphone industry, but also to tablets and post-PC products like the iPad and Galaxy Tab. In addition to the growing rate of mobile gadgets, the driving motivation behind the successful mobile games field is the existence of the distribution networks to promote the applications, which indirectly causes the number of mobile gamers increases up to 61%, based on current the study conducted by a gaming company, PopCap (2011).

Other than that, Derryberry A. (2007) declared games also can be focused or narrowed specially only for the learning purposes, or which she called as serious games that are targeted to assist the tutoring models. According to Anne, the serious game type of applications or games has been put into practice in military as to simulate the real situation of war, in corporate education and also in health care like for the impaired patients or children.

This claimed by her that games could be the use as the catalyst to achieve the goals of education industry by creating or build the similar environment (with the

real world examples) within the virtual game dimension. This will develop the sense of meaning behind playing the games as the actions determine the results. Apart from that, games are highly personalize and customizable to each individual. This is because as per stated by Anne; games are content driven rather than process based.

In fashioning the surrounding of a real world in gaming dimension, as reported by Ardito C., et al., (2010), the narrative flow is crucial to convey the meaning of a game. With this, the learning of a game, particularly to mobile game-based learning can be delivering to the user/player with less effort.

"...that games designed for mobile devices have considerable potential for encouraging learning, especially socio-affective learning, in young adults." - (Mitchell, et al., n.d.). Here, the author has concluded that games are also more appealing for mobile learning to student compared to conventional ways of teaching.

Likewise in accordance with Cogoi C., Sangiorgi D. and Shahin K. (2006), mobile game, typically to mobile game-based learning, is aim to raise the effectiveness and efficiency of teaching in any subjects, by using the furtherance of technology. The objectives were built on the foundation of studies that young generations are entailed not only for cognitive learning but also effective engaging session. Mobile games also based on their claims, provide the ease of use and effortless development. The content or subject learning are extremely customizable to personal references or according to the educational standards.

2.4 Mobile game based learning: Triumph over another

The learning in the 21st century does not have to be chained with the way it was before, which is the traditional method in delivering information to the listeners. Thus, by holding on to the advancement in technology, will enable the new and effective steps in teaching subjects in school, especially mathematics.

Stone R.M (n.d.) agreed that game based learning could gives huge benefits to the users, both to the educators as well as the students. This is because, according to her that game based learning is much engaging the students' attentions more than the "old-school" fashioned of teaching system as it is unique and fun (with the fact that these "modern" children are living in the front line of wave of the computerized innovation).

Besides, Raven also reported that game based learning helped the pupil to be much prepared with the real world situation or environment via the aid of the game simulations developed (tethered to the subjects or matters related, like a mathematical quiz game). This shows the teaching can be directly and indirectly explained and connected with the application of the subject in the real world basis.

What is more, game based learning also embedded with interactive, immersive contents to the learners and also provided first hand exciting experience to them, which is better than memorizing the facts.

2.5 Quiz puzzle game: Arcade style education application game genre

There is abundance of applications categorized according to different genres in the online store like the Apple App Store, especially games. Based on reports by McFarlane A., Sparrowhawk A. and Heald Y. (2002), the list can be classified as adventure/quest games, action, racing and also educational games. The education games can be further listed down as a portion of action game or arcade game app that is a puzzle (or quiz puzzle) game. These kinds of puzzle games are good to improve speed of response, automaticity, and visual processing according to Oblinger D. (2006). Among these application which specifically focused on educational apps (as per to this project), the author has choose 3 of educational game applications (for mathematics) in analyzing the model of games that these applications have provided. Following are some of the samples:

3 selected applications:
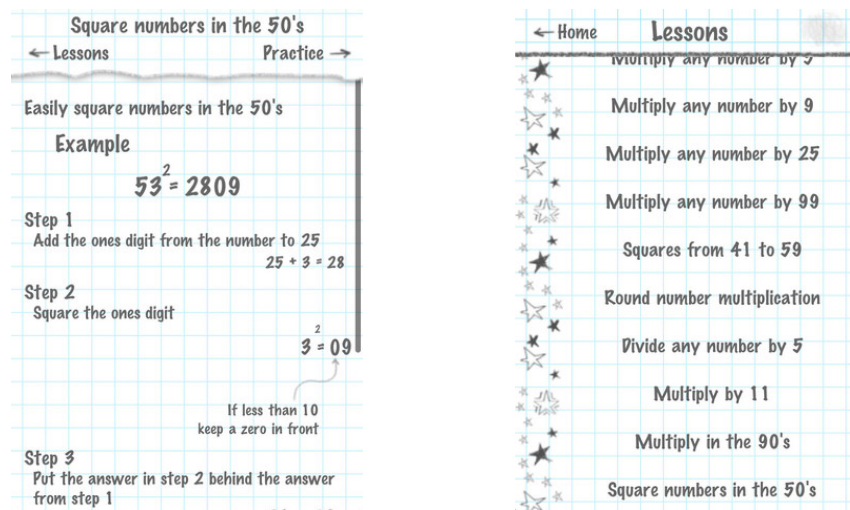
Figure 1: Mathemagics Tutorial and Lessons

a) **Mathemagics** - Mental Math Tricks – This is an education genre app, which only focuses on providing direct lessons besides, execises to the user. For the reviews of the application, Mathemagics is one of the best applications in learning mathematics regardless the level of the learner. The biggest draw to the application is that it helps the learner to learn math in an interesting way and with the quickest method. Firstly, the application provides tremendous tips and tricks in solving mathematical problems and equations. Apart from that, as a normal way to tease the mind of the learner, Mathemagics also packed with quizzes in keeping the mind fresh after education oneself with few math tricks. It also has variety of levels ranging from simple addition and subtraction puzzles to square numbers and power. This application resulting the increase in the learner's learning competency.

Figure 2: Operation Math

Figure 3: Stop villain

b) **Operation Math** - Operation Math is a simple action genre application that teaches young children in solving mathematical problem with game-like user experience. It has many complex game settings from the rest of the apps in the store. This application is designed with an adventures scenario thus engaging students as it introduces fun and wonders in learning math. The player needs to stop the villain that wanted to destroy even numbers and could only be stop by decoding the mathematics equations. It is targeted to children aged from 5 - 12 years old.
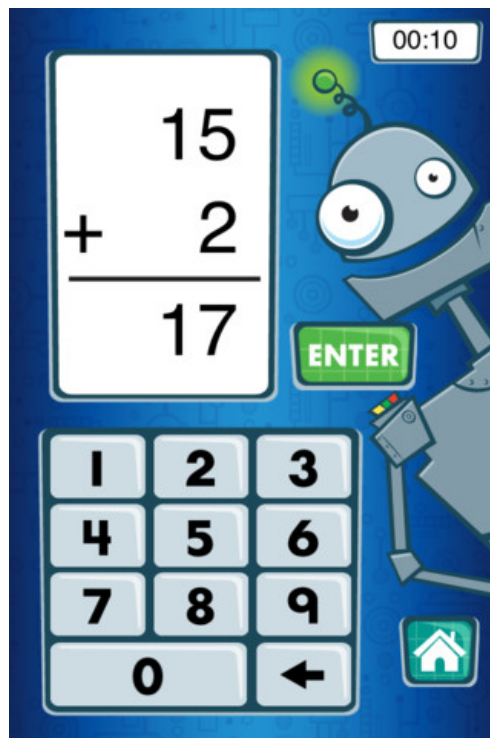
Figure 4: Robo Math Quiz

c) **Robo Math** - The application is basically mapped out to replace flash cards in teaching mathematics. Robo Math is an education quiz puzzle game which also a part of the whole education game genres in the app store. It fully equipped with fun and interesting quizzes. Other than that, the user could actually choose his or her own number to work with in mastering the problem regarding to the specific number. The huge fascinating feature of the Robo Math application is that it has a time tracker in boosting the user's capability to solve mathematical equations and puzzles.

For the project, the author had decided to develop a quiz puzzle game app that could aid the teaching process and provides a fun way to learn mathematics.

2.6 Theories of learning: Cognitive learning model

The models in learning indicate the ways of a certain individuals understand a particular topic or subject. What is interesting about it is that it varies across and among different people, whether the teachers or the students. Dunn L. (2002) stated that there are many theories out there that would explain the knowledge behind the each group of people perceived and learn. One of the theories was the cognitive learning model, which he describes as learning that depends on each individual method itself. Cognitive learning emphasizes on experience, meaning behind a phenomenon and the application of the knowledge on solving a problem. Lee also added that this learning model actually reflects that individuals are having dissimilarities in needs and concerns at different times, which resulting of having subjective interpretations on independent views.

The model is related to the project as the user is given a first-hand interaction of solving mathematical problems through game. Thus, the teaching of the subject mathematics is conveyed with real-world examples (the quiz questions).

2.7 Usability test

Testing is important in order to ensure the delivery of the application of meeting the requirement made earlier. According to Bias R. (2005), the considerations that should be taken into account in conducting testing of application were to identify the problem after built the application and measuring the overall satisfaction on the product. Here, the main purpose was to make sure that the scopes and objectives of the projects are hand-in-hand with the developed prototype and it is able to perform all the functions agreed in the blueprint/requirement made by the client.

The author decided to conduct on three criteria in testing the usability of Mobile MathTactics, which are:

- Success of user answering the questions
- Challenges in completing the mission

- Difficulty of questions provided

- Performance of the application

- Overall satisfaction on the application

- Feedbacks and comments

CHAPTER 3

METHODOLOGY

3.1 System development life cycle

System development life cycle (SDLC) is very important in any project in general, as it is a process of creating and refining the information system. It is a methodology used to initiate, develop and execute the system with the requirements met, which elaborates the overall methodology used in building a project, like in this case – Rapid Application Development.
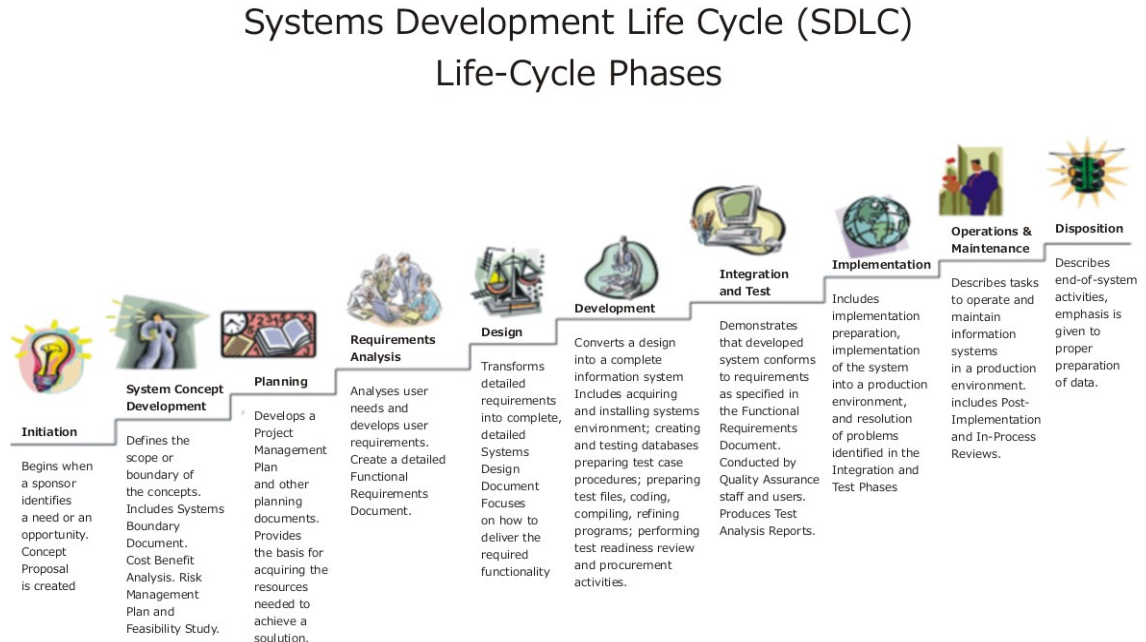
Systems Development Life Cycle (SDLC)
Life-Cycle Phases

Disposition

Describes end-of-system activities, emphasis is given to proper preparation of data.

Operations & Maintenance

Describes tasks to operate and maintain information systems in a production environment. includes Post-Implementation and In-Process Reviews.

Implementation

Includes implementation preparation, implementation of the system into a production environment, and resolution of problems identified in the Integration and Test Phases

Integration and Test

Demonstrates that developed system conforms to requirements as specified in the Functional Requirements Document. Conducted by Quality Assurance staff and users. Produces Test Analysis Reports.

Development

Converts a design into a complete information system Includes acquiring and installing systems environment; creating and testing databases preparing test case procedures; preparing test files, coding, compiling, refining programs; performing test readiness review and procurement activities.

Design

Transforms detailed requirements into complete, detailed Systems Design Document. Focuses on how to deliver the required functionality

Requirements Analysis

Analyses user needs and develops user requirements. Create a detailed Functional Requirements Document.

Planning

Develops a Project Management Plan and other planning documents. Provides the basis for acquiring the resources needed to achieve a soulution.

System Concept Development

Defines the scope or boundary of the concepts. Includes Systems Boundary Document. Cost Benefit Analysis. Risk Management Plan and Feasibility Study.

Initiation

Begins when a sponsor identifies a need or an opportunity. Concept Proposal is created

Figure 5: Example of SDLC

There are number of stages in the software development project:

1) **Planning of the system (feasibility study)** - The planning phase is basically deriving all the needs and idea of developing the project, where this phase provides the general background about the study. At the same time, goals are also conceived during the time to explain the importance of the project.

2) **Analysis of the system and data requirement definition** - This chapter further establishes the problems, objectives and scopes of the project, and married with the requirements of the project. In this phase also, all the data are synthesize to establish the solutions. Further functions and tasks are as well devised in this episode.

3) **Design of the system** - In this part, the functions and features are deeply detailed. This is to aid the development process later of the prototype. This step also describes more on the processes that should be done for the project besides preparing for the documentation.

4) **Implementation of the skeleton setup** - based on the design state, the development of the project is taken place during the timeframe.

5) **Integration, testing and deployment of the prototype** - After the development of the simulator, the pieces are bring together and examine to ensure the requirements of the project are met. In addition, before deploying the product, the prototype will undergo debugging period to patch most of its bugs of the system. Lastly, the project will be put into execution.

6) **Maintenance of the built system** - It is essential to constantly monitor the outcome on the usage of the system. This can be done through collecting the feedbacks from the user and provide the support to enhance the experience and functionality of the system.

From the system development life cycle (SDLC), it has the "give and take" in implementing the SDLC onto the project. Table below will display the attributes:

Table 1: Advantages and drawbacks of SDLC

Strengths	Weakness
Controlled environment and structural	Time consuming for the development

Strengths	Weakness
Applicable to big and small scale of projects	
Detailed information	Rigid development (restrictions)
Countable risk and cost	
Easy documentation	

3.2 Rapid Application Development (RAD)

Rapid Application Development or mostly known as RAD is a programming methodology that uses minimal planning and rapid development of prototypes in its process of application development cycle. This style of development method is highly flexible, as it requires less timeframe for the planning phase and focuses more on the creation of series of improved models based on changes in requirements. It is a robust model in building a functioning prototype according to series of devised manners and persistently refined and updated.

This model fits the project because the development of the application is very much needs for shorter planning period and focuses more on the development of the application itself. It also demands high level of interactions from the user to get the responds, which directly promoting collaborations between the developer and the user.

Rapid Application Development mainly has four stages in building the models:
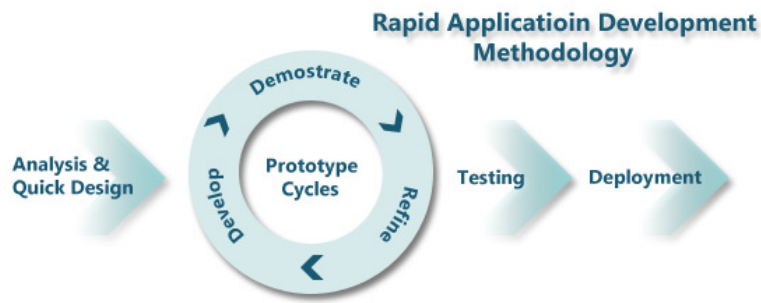
Figure 6: Rapid Application Development

1. **Requirements Planning Phase** - data collection and application requirements stage where the developer and the user agreed upon designed blueprint. At this stage, analysis of the problems and its solutions are done, and the activities did on this part are:

    a. Research in depth on the problem and formulating possible solution
    b. Further research on the learning theories
    c. Focuses on demographic study (targeted children aged between 9 - 10 years old) as the scope of the project
    d. Requirement and hardware selection
    e. Resource collections which all were taken from the internet
    f. Research on suitable app genre

2. **User Design Phase** - creating the flow of the application with graphical workflow on the behaviors, actions and functions that the application should have. This timeframe and the next stage demanded massive user interactions with various improved prototypes developed. At this chapter:
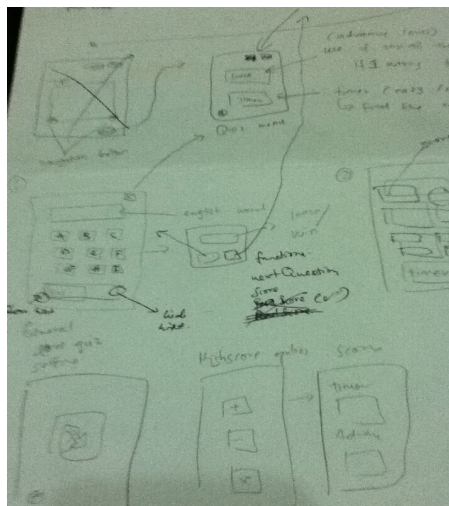

Figure 7: Sketches of rough idea

16

a. Design of the prototype of the application

b. Flow of the game (storyboard) is build. For example, the first action upon launching the app, the user will be given options to choose mathematical operations. Then, the app will proceed presenting the quizzes.

c. Design of the screenplays and its workflow (action flow)

3. **Construction Phase** - the actual development period of the program which is based on the earlier discussions. Here, at this phase, the development of the application is constructed using the Software Development Kit and also third party creativity application like Pixelmator to draw the characters, layouts and such. This chapter however will continue to be repeated with going back to the second phase as to fine-tune the prototype.

4. **Cutover Phase** - Final step in creating the application. The final model of working application is rolled out during the phase after tested out before hand.

The summary of above commentaries can be simplify in the figure below:

Search for a suitable learning model → Find a suitable game genre → Lay down general outflow of prototype → Develop prototype → Prototype testing and refining
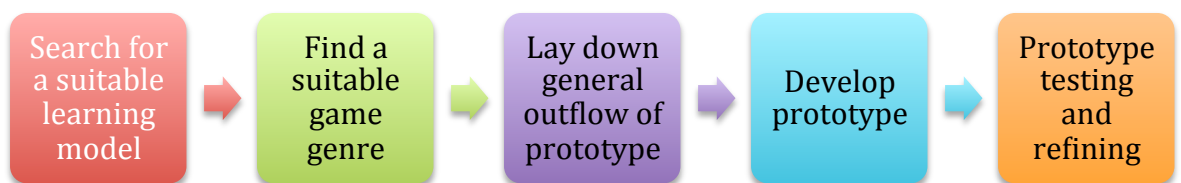
Figure 8: Overall project activities

This type of methodology imparts abundance of benefits to the developer. For example, it is highly flexible in terms of developing and planning of the project. The developer can choose to add or discard features based on the necessity of the project (through the analysis of the survey and feedback from the user). As an instance, Mobile MathTactics can increase its level of difficulties or to reduce it according to the education structures and standards.

Because of that, the functionalities of the prototype are also able to be change - like escalating of the functionality to up-to-date contents. Not only that, the application can take full advantages of the advance hardware of the host devices and also the software equivalent.

On top of that, rapid application development also permits the developer to be more concentrate on the specific problem solving area. This helps the developer to not worry on the whole system but rather on particular parts that need attention.

By constantly comparing the result (prototype) with the requirements, the developer is competent to see and measure the level of accuracy of the project. With this, the project meets all the objectives and solves the problems that it supposed to address.

So, as the conclusion rapid application development (or RAD) does:

1) Flexibility in its overall software development
2) Able to update and adapt the development of the project with the latest elements
3) Developer can increase or decrease the functionality of the project founded by the project's needs and requirement.
4) Focused on specific area on problem solving part
5) Able to measure the accuracy of the project against its objectives
6) Reduces the time and cost in planning part
7) Improve and increase the user interaction

3.3 Project Activities

Gantt chart (proposed timeframe)

Final Year Project 1: July 2011

Table 2: FYP 1 Timeline

ID	Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1	Final Year Project 1	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
2	Selection of Project Topic	🟩	🟩												
3	Preliminary Research Work		🟩	🟩	🟩	🟩									
4	Problem Identifying and Literature Review			🟩	🟩	🟩	🟩	🟩							
5	Submission of Extended Proposal							🟥							
6	Project Research and pre-development						🟩	🟩	🟩	🟩					
7	Project analyze and synthesis						🟩	🟩	🟩	🟩					
8	Proposal Defense								🟩	🟩					
9	Project Works Continues										🟩	🟩	🟩		
10	Submission of Interim Draft report													🟥	
11	Submission of Interim Report														🟥

Final Year Project 2: May 2012

Table 3: FYP 2 Timeline

ID	Task	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
1	Final Year Project 2	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2	Project Development	■	■	■	■	■	■	■								
3	Submission of Progress Report								■							
4	Project Development Continues								■	■	■	■	■			
5	Pre- EDX											■				
6	Submission of Draft report												■			
7	Submission of Dissertation (Soft Bound)													■		
8	Submission of Technical Paper													■		
9	Oral Presentation														■	
10	Submission of Dissertation (Hard Bound)															■

Week	W
FYP 1 Progress	■
Tasks Progress	■
Milestone/Dateline	■

3.4 Tools required for the project

3.4.1 Software and Hardware

For the development of the application, the author has chosen few tools that will help to pull out the application into action. Above all, the programming language chosen for the project is Objective-C, which is the heart of all the operating systems that runs the Macintosh computers and also all Apple Inc's post-PC products like the iPad, iPhone and iPod touch – the iOS.

Next, the tool that enables the coding editing process, compilation and also the interface builder is Apple Inc's own proprietary software development kit application, the bundle kit app – Xcode 4. Xcode is the editor for creating and build the application into the mobile operating system the iOS. In addition to Xcode, there is also the Instrument application used for debugging purposes.

For the host device, it will be either an iPad or and iPod touch with the latest operating system version, which are the iOS 4.0 or iOS 5.0 or above. And for the development and coding part, an Intel-based Mac computer is used with also the latest OS, Mac OS X - Lion v10.7 or Snow Leopard v10.6.6.

3.4.2 Questionnaires

For the survey, the author had formulated fives (5) questions will be formed in Likert scale (1 being strongly agree or easy to 5 being strongly disagree or hard – which depends on the questions asked) and then open ended questions about extra comments or feedbacks will be given to evaluate the effectiveness of the of Mobile Mathtactics.

Table 4: Survey questions

No.	Item	1	2	3	4	5
1	User is able to answer most of the questions in the quiz easily and with perfect scores					
2	The mission of the application is understandable and can be completed					

3	The questions posted in the quiz of the application is (1 – very easy, 5 – very hard)					
4	Mobile MathTactics application performances					
5	The overall satisfaction of the application to the user on meeting the requirement and its objectives					

CHAPTER 4

RESULT AND DISCUSSION

This aspect combines the identification of problems for the project and its collections of data. This is primarily for lubricating the development period of the model of the application. Below are some of the concepts and ideas on how the author has decided in structuring the earlier prescribed blueprint of the Mobile MathTactics.

4.1 Online observations and interviews for data collection

The online gives vast information especially on the matter of interest, which are about mathematics, available technologies, the learning models, and setbacks that caused math to be undesirable to most students generally to young children. From the net, the author has found some research papers done by various study groups and universities, that supply such crucial statistics and data on math, games and mobile gaming preferences as learning base. Other than that, also the author had visited some official websites that describe on the mobile technology, mobile learning and its connections with subjects such as math, which covers huge aspect of demography. Apart from that, learning theories also had been chosen carefully to suit to the project requirement, which was the cognitive learning theory. Withal, some online documentation for the tools used also help the author to choose the best platform to implement the project.

The author also had done some interviews with school teacher of SK Matang Jaya to evaluate and also for the background information before develop the app through emails interviews.

4.2 Quiz puzzle game application as the proposed project

Since the data analysis results from the online material and the interview are more sided on making engagement with the student and creating a fun learning environment, and also based on the research on mobile technology, the author had decided to build a mobile game puzzle (quiz game puzzle) application which is based in iOS platform. This is due to the potential of the application for future perspectives in commercializing it.

4.3 Mathematical module selection

From the interviews and the online materials data collection, the author had come out with few decisions for the module on which Mobile MathTactics supposed to tackled and also meet the objectives.

Since the targeted demographic are children aged between 9 to 10 years old (which is those who are in primary 3 and 4 students), the author had chooses three modules (three mathematical operations as the modules) for the gameplay options. The modules are subject on:

1. Addition operation
2. Subtraction operation
3. Multiplication operation

These operations will act as starting points for the quizzes, as those questions will be asked according which module that have been selected. Here, the scores will be collected on each question that has been answered correctly.

4.4 General flow of the game

Before the prototype was developed, the general workflow was determined.
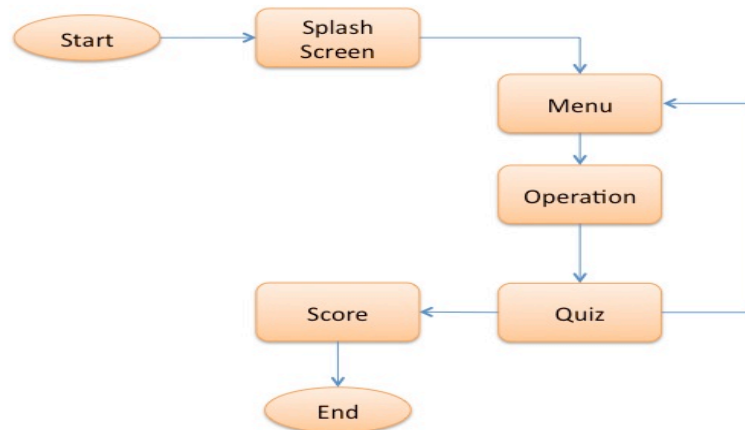Below is the flow of the game:

Figure 9: General flow chart of the application

Above figure shows the general idea on how Mobile Mathtactics will perform. From
launching and starting the application, the user will be welcome with the splash
screen while waiting for the application to completely load. Then, a menu screen will
be displayed providing the player with options – start, setting options and high
scores. Setting options will direct the player to the settings of the application, where
the player is able to set the sound of the application, resetting the scores back to
default settings and also a tutorial on how to play the application through "How to
Play" section. High scores will present to the user with high scores gained from
previous played activities. For the start option button, the user will be given options
to choose mathematical operations, which the user wishes to test his or herself on,
and will directly begin the quizzes (set of questions) and the quizzes ended when all
the questions were answered. The score will be displayed after the each and also all
questions ended.

Mobile Mathtactics also have timer for the user to keep him or herself check with the player's own competencies in answering mathematical problems as presented in the application.

4.5 Storyboard, sketches and screenshots of the application

In developing the application, the author had done some rough sketches to determine the storyboards, actions performed, layout and such to ease the real development of Mobile MathTactics.
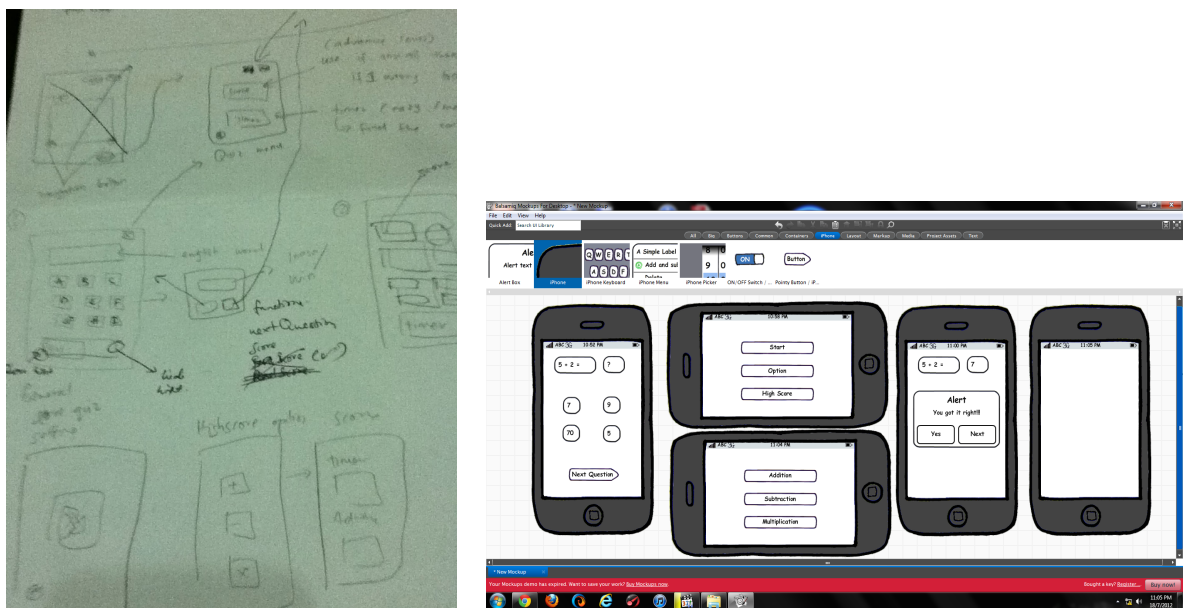

Figure 10: Rough earlier sketches and layouts

Above figures are examples for the rough idea of the application's tasks and action that it should be able to do. Also, the layout and look of the Mobile MathTactics also been conceived at the same time.

Below are the screen shots also with the storyboard descriptions (the numbers indicating the sequences of the flow):

1. Splash Screen

Figure 11: Splash Screen

This is the first screen upon launching Mobile MathTactics – Splash Screen. It is very important to have this part as to hide the activities happening in the background for the application to completely load the quizzes.

2. Menu Screen

Figure 12: Menu Option Screen

After the splash screen and the application finished loading, the menu screen will be presented. Here, the player will be given three options to choose from: - Start, Options or Settings and High Scores buttons. Each of these buttons will navigate to its own user interfaces.

3. Operation Menu Screen
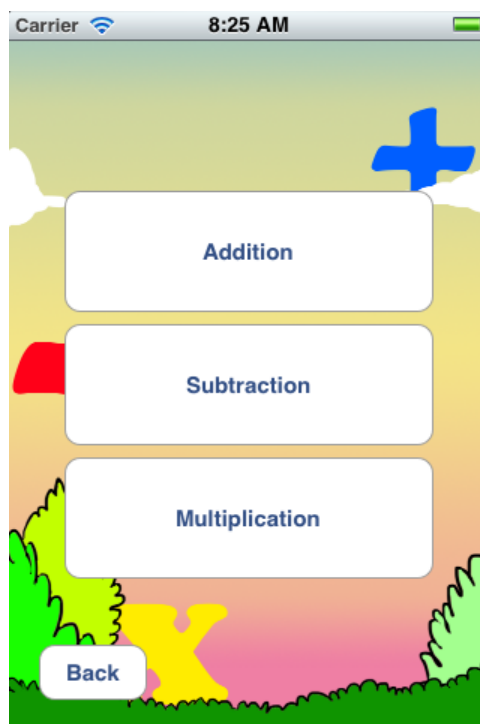
Figure 13: Operation Menu Screen

If the user clicked on the start button, the operation menu will be display. Here, the player can choose on the operation that the student wishes to focus on. In this screen also, the buttons presented will reflect the mathematical modules that have been selected for this project: - Addition, Subtraction and Multiplication.

4. Quiz Game Screen and Score Screen
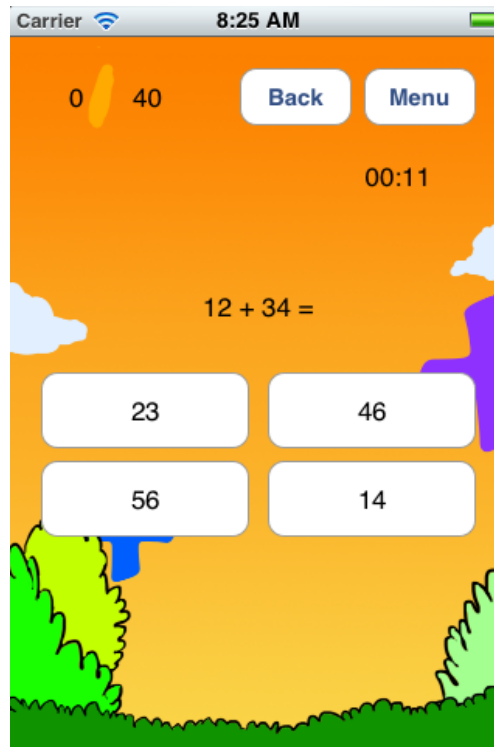
Figure 14: Quiz Screen

This is the quiz game screen. The quiz will have several levels, like the above screen is the level one difficulty screen. Generally, all the level screens will have similar look except with few differences like the position of the timer. Each question will be given a time to answer it correctly, like for level one, 15 seconds and level two for example, 30 seconds. For each correctly answered question, the score will be awarded and if the question was not answered within the time limit or correctly, not score will be given. Each question carries 10 marks. Only a fully scored level will enable the player to proceed to the next level. Below is the score screen after each question posted.
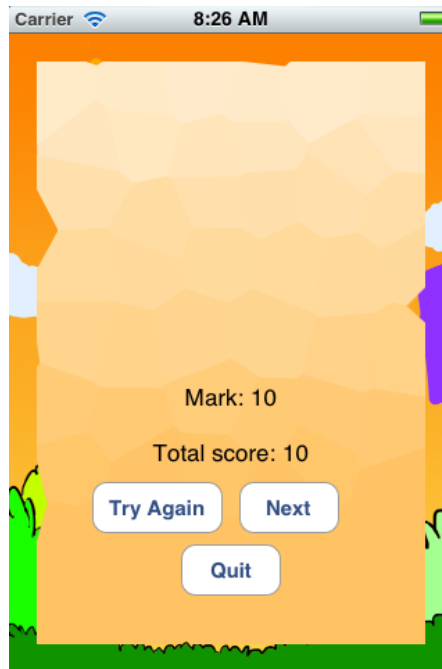
Figure 15: Score Screen

The score screen will be displayed after the question is answered. It will provide the score information, the total score details and also the buttons for the player to try again, proceed to the next questions or level and quitting the quizzes which will navigate to the mathematical operation selection menu screen.

Those are the general storyboard and screen shots for the overall flow of the game application. Below however the options screens which do not directly apart of the general game flow of Mobile MathTactics.

5. Option Screen and the Tutorial Screen

Figure 16: Setting Screen

This is the option menu screen, where the player could alter the sound system of the application, to learn on how to play the game and also resetting the scores of the game.
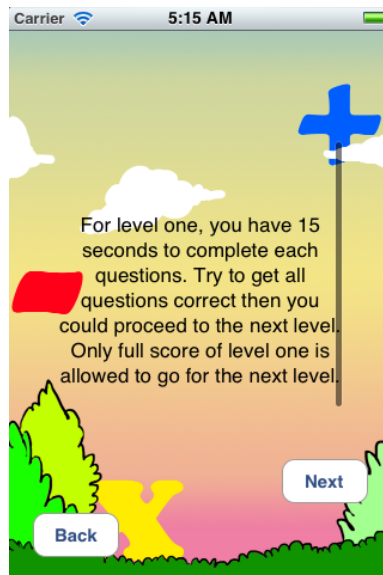

Figure 17: How to Play Screen

The "How to Play" screen exhibits the tutorial and know-how on how to play the game as well as the completing the mission of the application.
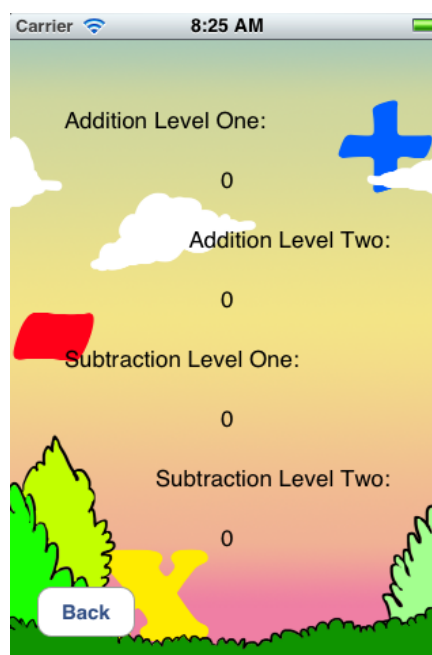
6. High Scores Screen

Figure 18: High Score Screen

The high scores screen will displayed all the scores from the quizzes (in all the mathematical operations). The view can be scrolled.

4.6 Results of analysis

After conducting some survey and testing with ten students with the help of the author's teacher and through emails communication in which the teacher was agreed to help the author in conducting the survey as well as testing the application, the author had concluded the analysis and outcome data, which are illustrated in the following graphs:
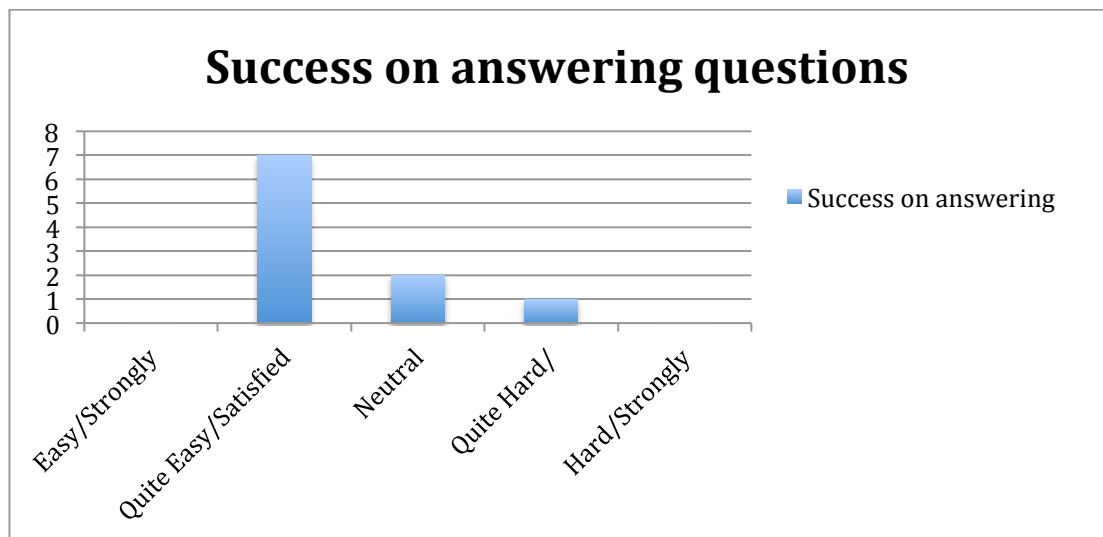
1. Success on answering questions

Figure 19: First question graph

The above graph shows the result of the rate of the user on answering the questions successfully and correctly. Most of the participants were able to answer the questions in the quiz correctly and only a few of them thought that the questions sometimes tricky and a bit hard to be answered. This is maybe due to the timer of each of the question.
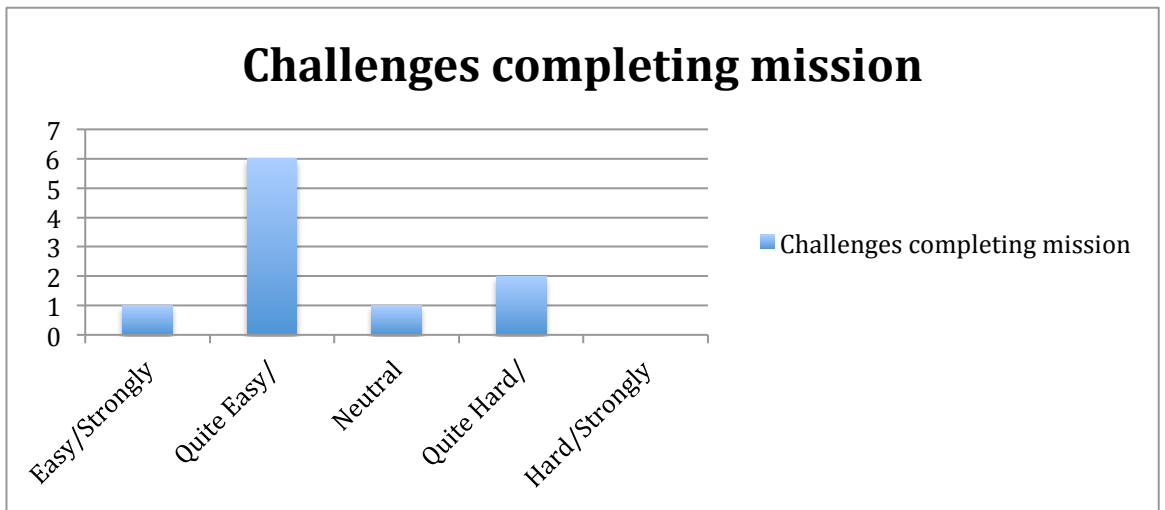
2. Challenges completing mission

Figure 20: Second question graph

60% of the participants found that the mission in completing the quizzes within the time limit was achievable. Meanwhile, 20% of the users were struggling to complete the missions probably due to the question's difficulties or hardness level.
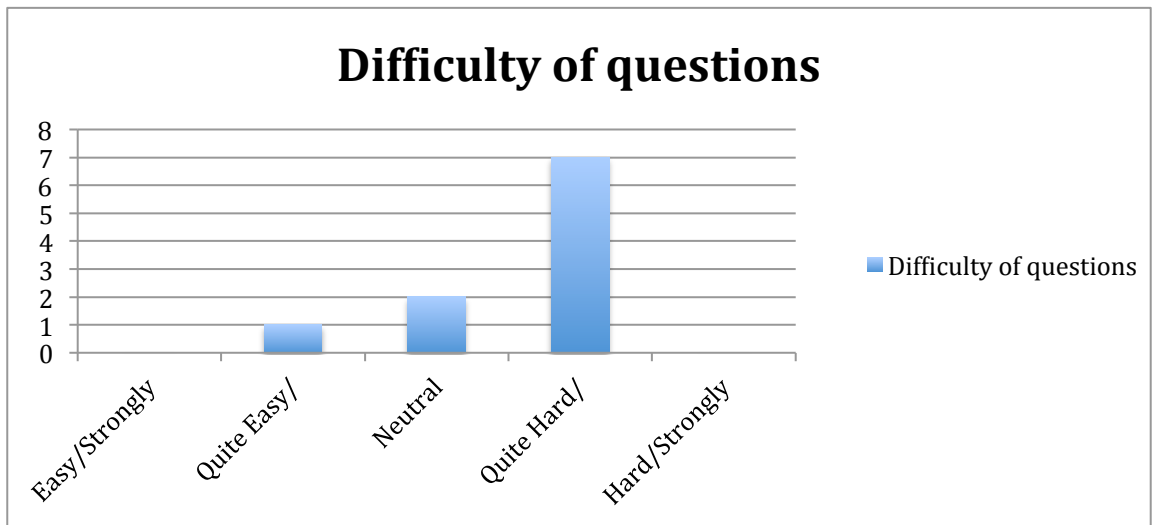
3. Difficulty of questions

Figure 21:Third question graph

Most of the participants found that the questions given were quite challenging for them, especially added with the mission and the timer. The participants need more time to compute the questions and also to extract information as different levels presented with bigger numbers like in hundreds and thousands.

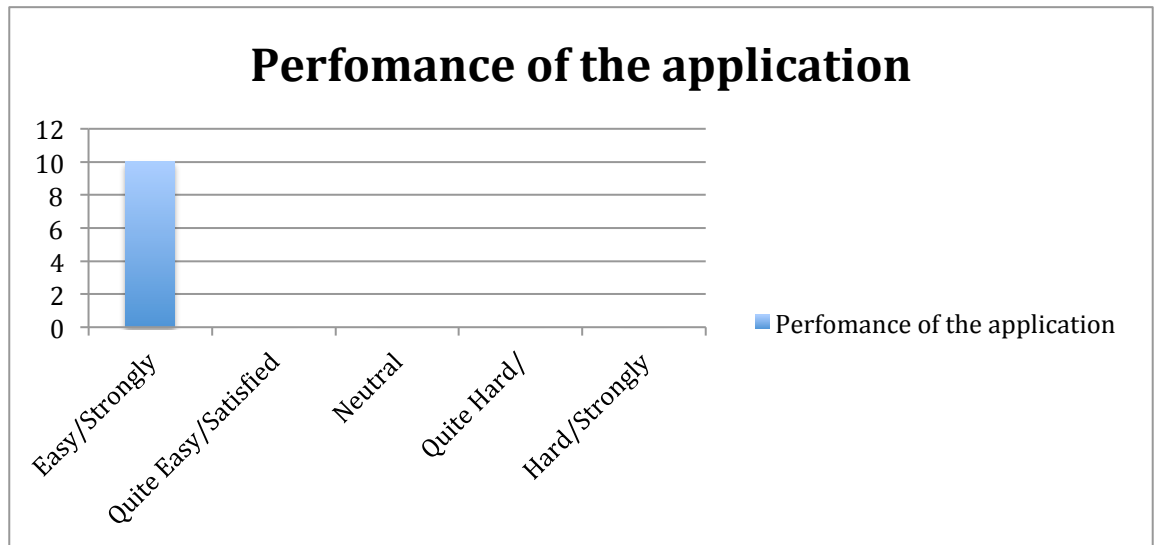4.   Performance of the application

Figure 22: Forth question graph

Due to the nature in developing in iOS, the performance of the application has to be evaluated to prevent it from becoming sluggish. From the outcome of the survey, all of the participants agreed that Mobile MathTactics responded quickly and fast.

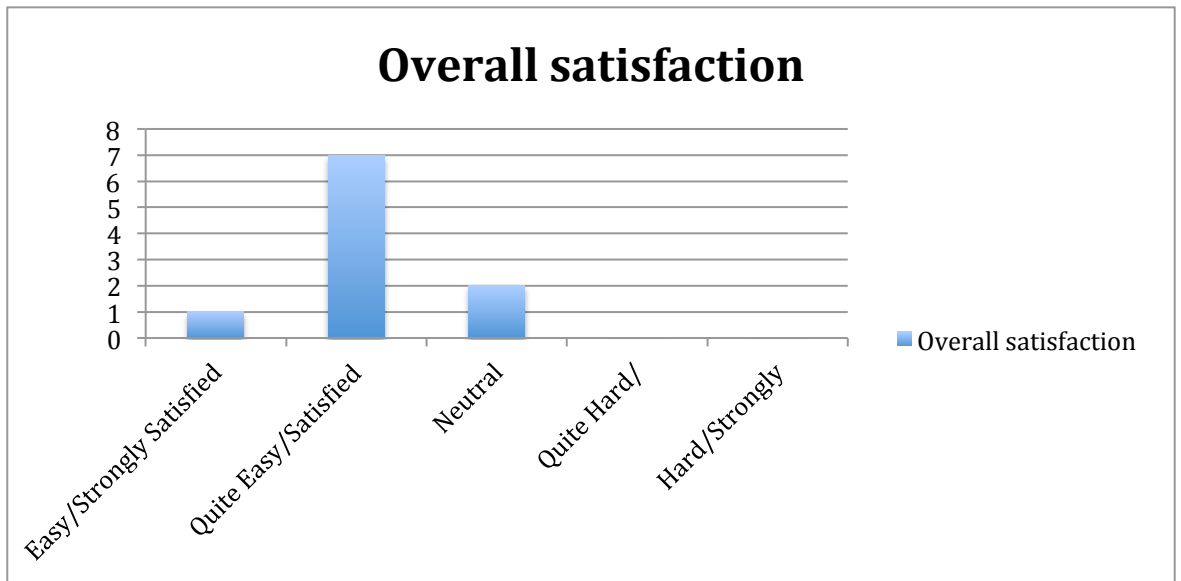5. Overall Satisfaction on the application

Overall satisfaction

Figure 23: Fifth question graph

About 70% of the users were satisfied with the application meeting its objectives and only 20% were feeling neutral on the impact of the application with the student's studies.

As the conclusion, the application was found to be suitable and able to meet the objectives and scope of the study, which is creating a mobile learning game application (quiz education application) app for youngsters aged 9 to 10 years old. Mobile MathTactics also able to functioning well as desired in is blueprint concept. The users' feedbacks and comments will be put under the recommendations for the project in the next chapter. Other than that, Mobile MathTactics is able to deliver the desired outcomes.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Recommendation

The prototype still needs a lot of improvements and tweaks in making it more commercial – all is based from the user's feedbacks and comments. Firstly, the application needs to be able to make multiple user profiles thus this will enable multiusers ability for collaboration gaming purposes in future. Apart from that, Mobile MathTactics should be able to generate random questions, as this will prevent same questions from being repeated. Next, the application could add more missions other than the timer and all correct questions answered missions as to add more complexity and fun to the app. Lastly, Mobile MathTactics seriously needs a better sound and graphic improvements in making the application much attractive and better, especially to the questions besides using a text-based format. Also, as the option bonus to the graphic, the application can add more physic engine features as to keep the application become interactive.

5.2 Conclusion

Mobile MathTactics is able to create a fun learning environment to the students and also engaging them to study mathematics even further. The application has successfully extending the learning beyond the border of the classrooms and schools. Although Mobile MathTactics still need more improvements in order to make it more stable and much better, the application has a bright hope in providing the 21st century's way of teaching.

REFERENCE

[1] Baez J. C. 2007, Why Mathematics is Boring. Retrieved from
http://golem.ph.utexas.edu/category/2007/04/why_mathematics_is_boring.html

[2] Geddes S.J 2004, Mobile learning in the 21 century: benefit for learners. Pp. 2-3. Retrieved from
knowledgetree.flexiblelearning.net.au/edition06/download/geddes.pdf

[3] Stone R. M. n.d., "The Advantages of Implementing Game-Based Learning into the Curriculum and The Influences of Instructor and Student Perceptions". Retrieved from http://www.nevarmore.com/seniorproject/gamingproposal.pdf

[4] Oblinger D. 2006, Simulations, Games, and Learning. Pp 4. Retrieved from
http://net.educause.edu/ir/library/pdf/ELI3004.pdf

[5] Dunn L. (2002), "Theories of learning". Retrieved from
http://www.brookes.ac.uk/services/ocsld/resources/briefing_papers/learning_theories.pdf

[6] Mitchell A., Inchingolo P., Vatta F., Grocer J., Cisic D., Petrovich O., Kittl C., Hans Joerg Penh (n.d), mobile Game-Based Learning to promote decision- making skills – a pan- European project. Retrieved from
http://www.m4life.org/proceedings/2006/PDF/19_Mitchell.pdf

[6] Apple Inc. (2011), Apple - Education - iPod touch and iPhone enable on-the-go learning. Retrieved from http://www.apple.com/education/ipodtouch-iphone/

[7] Information Solution Group (2011), Mobile Gaming Survey Results 2011: PopCap Games Mobile Phone Gaming Research.

[8] Derryberry A. (2007), Serious games: online games for learning.

[9] Ardito C., Sinters C., Raptis D., Yiannoutsou N., Avowers N., Costabile M. F. (2010), Design Guidelines for Location-based Mobile Games for Learning.

[10] Cogoi C., Sangiorgi D., Shahin K. (2006), mGBL – mobile game-based learning: perspectives and usage in learning and career guidance topics. Retrieved from http://www.elearningeuropa.info/files/media/media10911.pdf

[11] Kislenko K., Grevholm B., Lepik M. (n.d.), "MATHEMATICS IS IMPORTANT BUT BORING": STUDENTS' BELIEFS AND ATTITUDES TOWARDS MATHEMATICS. Retrieved from http://prosjekt.uia.no/lcm/papers/Kislenko.pdf

[12] Apple Inc. (2011), Apple iTunes App Store. Retrieved from http://itunes.apple.com/

[13] McFarlane A., Sparrowhawk A., Heald Y. (2002), "Report on the educational use of games". Retrieved from http://www.google.com.my/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CFEQFjAA&url=http%3A%2F%2Fonderzoek.kennisnet.nl%2Fattachments%2F%2B1662254%2Fgames_in_education_full.pdf&ei=gWcGUIPrA4borQe24ejFBg&usg=AFQjCNGPULHFylamnTpzQ7U0IiGccWG3MQ&sig2=AaR3WqxHnI8Zb5gyJ_gJ6w

[14] Stone R. M. (n.d.), "The Advantages of Implementing Game-Based Learning into the Curriculum and The Influences of Instructor and Student Perceptions". Retrieved from http://www.nevarmore.com/seniorproject/gamingproposal.pdf

[15] Bias R. (2005), "Usability Test Plan". Retrieved from
www.rachaelgilg.com/docs/testplan_final.pdf

[15] Bias R. (2005), "Usability Test Plan". Retrieved from
www.rachaelgilg.com/docs/testplan_final.pdf

Appendix

1. Interview (Miss Norshimah Bujang – SK Matang Jaya):

Miss Norshimah Bujang: Teacher

Mohd Zulothman Mustapha: Author

Email conversations:

Author: Assalamualaikum miss, I'm Mohd Zulothman Mustapha, ex-student of SK Matang Jaya of 2002. I'm currently at Universiti Teknologi Petronas, doing my final year as an ICT student. FYI, I'm doing my final year project and I would like to ask for your assistance to help me with my project. I'm doing an application like a game like app for students of primary 3 and 4 of the subject mathematics. The application uses English as its medium. Thus, my concerns that I would like to ask you are:

    a.   What are your views on the subject mathematics? Is it difficult or an easy subject to the students under your care?

    b.   What kind of interesting ways that you used to educate them?

    c.   Which mathematical modules that are mostly students have difficulties in scoring them?

    d.   How would you personally want to change the current teaching methods used by all the teachers around the country if you were given the chance to do it?

For now, that is all the questions that I would like to know for my fyp. And if you could assist me more, would you mind to help me later on the testing of the application and a survey for my project?

Hopefully I would not cause you any burden. Thanks for everything and your coorperation.

Teacher: Waalaikumsalam Mohd Zulothman. It's great to hear from a former student of SK Matang Jaya that has done so well. And of course, I'd love to help you. For your questions, the answers are:

1.	The subject is quite alien to those students of primary 3 and 4 as this is a typical behaviors of today's children. Overall, the subject is not that hard as it's just the addition on more numbers. But, since the students are quite lazy to do revision, thus that's why it is quite difficult to them.

2.	I usually just teach them the same way as other teachers educate any other students. I do not particularly have any interesting method to "wow" them. Just ordinary style.

3.	For now, the students need attention to most of the mathematical operations problem. This includes addition, subtraction, multiplication and fraction or division. This probably we have limited time to cover the whole syllabus so that makes it so hard for us teachers to gives specific attention to them as we also have our own tasks as educators. But if they could focuses on the mathematical operations like addition and subtraction, that'd be nice.

4.	I personally would love the idea of using game to teach the student as it attracts the students' attention instantly. This however still depends on the policies of the school so maybe it is time to change to that direction? Haha… I'm just guessing.

And I would love to help you with you testing and survey and all. Just give me the further details and updates.

2.	Survey Questions

No.	Item	1	2	3	4	5
1	User is able to answer most of the questions in the quiz easily and with perfect scores					
2	The mission of the application is understandable and can be completed					
3	The questions posted in the quiz of the application is (1 – very easy, 5 – very hard)					
4	Mobile MathTactics application performances					
5	The overall satisfaction of the application to the user on meeting the requirement and its objectives					