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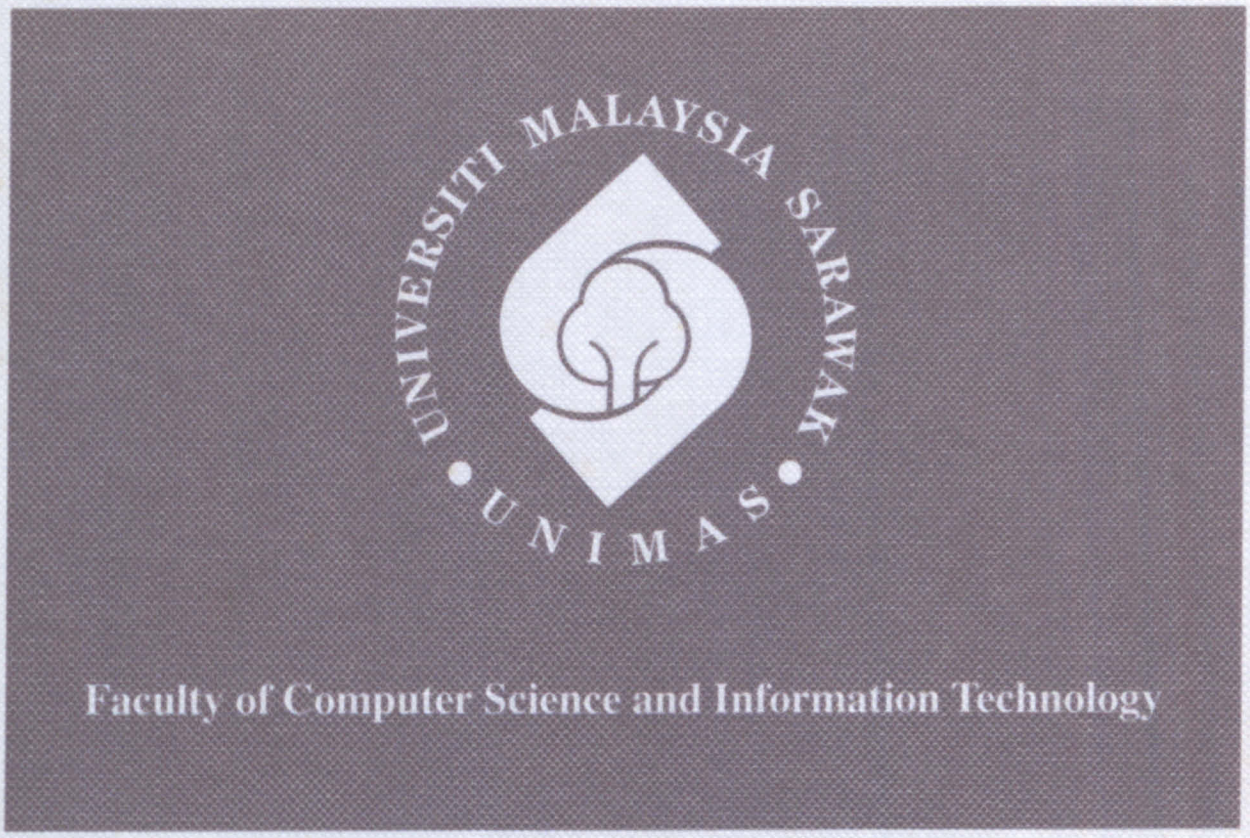

DEVELOPING AN INTERACTIVE MATHEMATICS GAME USING SCRATCH PROGRAMMING

Nurul Syuhada Binti Joini

Bachelor of Computer Science with Honours
(Software Engineering)
2015

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UNIVERSITI MALAYSIA SARAWAK

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P.KHIDMAT MAKLUMAT AKADEMIK
UNIMAS
1000288357

NURUL SYUHADA BINTI JOINI

This project is submitted in partial fulfilment of the

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MEMBANGUN PERMAINAN INTERAKTIF MATEMATIK MENGGUNAKAN PENGATURCARAAN SCRATCH

NURUL SYUHADA BINTI JOINI

Projek ini merupakan salah satu keperluan untuk

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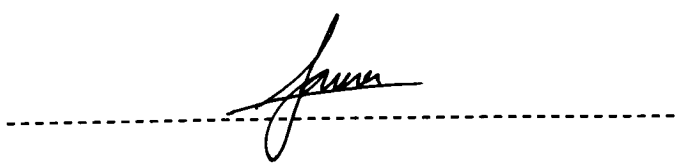
This Final Year Project Report entitled "Developing an Interactive Mathematics Game Using Scratch Programming was submitted by Nurul Syuhada in partial fulfilment of the requirements for Bachelor Degree of Computer Science (Hons.) Software Engineering, in Faculty of Computer Science & Information Technology, and was approved by



Nurfauza binti Jali

Supervisor

Nurfauza Jali
Lecturer
Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK

Department of Computer & Software Engineering

Faculty of Computer Science & Information Technology

Universiti Malaysia Sarawak

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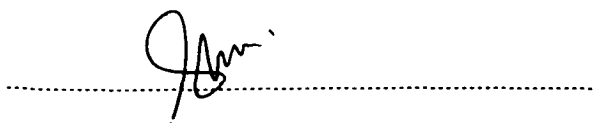

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Validated by

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Nurfauza Jali
Lecturer
Faculty of Computer Science and Information Technology
UNIVERSITI MALAYSIA SARAWAK

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LIST OF ABBREVIATION

DGBL – ID	Digital Game Based Learning – Instructional Design
ID	Instructional Design
IT	Information Technology

ABSTRACT

Mostly students perceived learning mathematics is difficult. Hence, it is essential for parents and teachers playing their part to attract the students' interests. In the globalization of the modern world, there are lots of technologies have been developed by new Information Technology (IT) generation to make life easier. As what people said, "The information is all at the finger tip". Thus, the method of integrating the elements of technology with a learning process is a new approach to capturing the students' interest. The most suitable approach to be used is developing an interactive game. The purpose of this project is to create a new approach to teaching the children in learning mathematics and provide a strong foundation for them on their high-level learning. The target group will be the children from the age of 5 to 9 years old. In addition, the Scratch programming will be used to develop new skills in children and capture their interests in exploring IT skills and field.

ABSTRAK

Kebanyakkan pelajar menggangap mempelajari matematik itu suatu yang sukar. Justeru, ianya menjadi suatu tanggungjawab bagi ibu bapa dan guru memainkan peranan untuk menarik minat para pelajar. Di dalam globalisasi dunia moden, terdapat pelbagai teknologi yang telah dibangunkan oleh golongan celik Informasi Teknologi (IT) untuk memudahkan kehidupan seharian. Bak kata pepatah, "Informasi kini berada di hujung jari". Oleh itu, kaedah menggabungkan elemen-elemen teknologi di dalam proses pembelajaran adalah suatu kaedah untuk menarik minat para pelajar. Salah satu kaedah yang sesuai adalah dengan membangunkan permainan interaktif. Tujuan projek ini dijalankan adalah untuk mengolah satu kaedah untuk mengajar kanak-kanak terutamanya dalam mempelajari matematik dan menyediakan satu asas yang kukuh untuk mereka melanjutkan pelajaran ke tahap yang lebih tinggi. Sasaran kumpulan bagi projek ini adalah kanak-kanak atau pelajar yang berumur dalam likungan 5 hingga 9 tahun. Tambahan juga, penggunaan pengaturcaraan Scratch akan digunakan dalam projek ini untuk membina skill baru di dalam diri kanak-kanak tersebut dan menarik minat mereka dalam meneroka lebih mendalam dalam bidang IT.

CHAPTER 1: INTRODUCTION

1.1 Introduction

In our daily routines we played with lots of numbers without we even noticed it or not. From the moment we wake up in the morning we often look for the watch for time until we sleep again at night. In other words, numbers are important for us in life to give us limitations and set our capabilities. Through the knowing of numbers will lead to development of mathematics skills. However, the achievements in mathematics are not satisfactory among the students in schools. Competencies of basic numbers are formed at the early age (Jordan & Levine as cited in Kelanang & Zakaria, 2012, p. 1086). As stated by Kelanang and Zakaria (2012),

> *Efficiency in mathematics is a crucial skill to individual today. Strong mathematics foundation will lead to better understanding and mastering in higher level mathematics concept in the future. However, failure of acquiring the foundation knowledge and concepts will affect the interest and confidence of the student in learning mathematics* (Kelanang & Zakaria, 2012).

However, student perceived mathematics subject is difficult. Studies showed that the learning environment are boring and not capture student interests in the learning environment. Thus, it is essential to come up with a new approach to teaching the student such as developing interactive learning games. Aside having fun from the games, children can acquire knowledge from the games. To imply the new learning environment in children are not a difficult task to do because studies showed that games are positively accepted among children and teenagers (Mat Zin, Jaafar, & Wong, 2009, p. 322). Latif studied that majority (92.1%) of student in 16 schools involved showed that they are experienced in playing computer or video games (as cited in Mat

Zin, Jaafar, & Wong, 2009, p. 322-23). Overall, the development of games can benefit creating a new learning environment.

The purpose of this project is to create a new approach to teaching the children in learning mathematics and gives a strong foundation to them for their high level learning. The target group will be the children of the age of 5 to 9 years old. In addition, the Scratch programming will be used in order to develop new skills in children and capture their interests in exploring the IT skills and field.

1.2 Problem statement

Mathematics achievements among Malaysian students are not satisfactory enough as compared to other countries. Studies showed that there are few factors causes this to happen such as tools and methods, the language used and perspective held by parents, teachers, and children itself about the nature of mathematics learning and teaching. Due to this, students are facing difficulties in learning mathematics theories. It is required for children to have strong basic skills in mathematics to pursue the skills to high level and more complex concepts. However, to teach such young age is quite difficult. Thus, effective ways are essential.

It is true that the society is familiar with technology. The used of information technologies (IT) especially the usage of smart-phones, games and various applications are widely used by all level of the age in society. Parents of millennial are likely to expose their children to these technologies and from general observations showed that children can adapt faster. However, these young generations are more exposed to only using the technology instead of developing the technology. In Malaysia specifically, the exposure of developing information

technology (IT) field not really focus on because the awareness among Malaysian for the field are still at a low level. Unlike the first world class country, the development of technology among children has been presented as early as kindergarten level. Introduction to simple and interactive programming is a good way to introduce this field to children such as scratch programming.

The combinations of mathematics subject with skills in Information Technology (IT) such as programming produce good learning games that can educate children and increase their achievement in the area.

1.3 Objectives

i. To provide a platform in learning basic Mathematics skills under game based learning environment.

ii. To develop Mathematics game based learning using Scratch programming tool.

iii. To introduce fundamental programming skills by engaging Scratch programming tool in the project.

1.4 Methodologies

The methodology can be described as procedures which carried out few steps of actions accordingly in the development of a project. In order for developers to achieve success in their project, they can follow the chosen or suitable methodology.

For this project, the Digital Game Based Learning – Instructional Design Model (DGBL-ID) by Mat Zin, Jaafar and Wong has been chosen as the project's methodology.

Instructional design (ID) which is the one component is most commonly used in game development project especially in learning based games. Smith and Ragan's study,

Instructional design is a systematic and reflective process of interpreting principles of learning and instruction into plans for instructional materials, activities, information resources and evaluation. Instructional designers need to analyze, plan, implement and evaluate in such a way that their work will do the best with the least harm, and to learn from mistakes to improve. (as cited in Mat Zin, Jaafar, & Wong, 2009)

The Digital Game-Based Learning – Instructional Design (DGBL – ID) Model (Mat Zin et al, 2009), is an educational game design and development model is developed based on Instructional Design (ID) and game development methodology. The DGBL – ID model consists of five phases, which are analysis phase, design phase, development phase, quality assurance phase as well as implementation and evaluation phase. For each phase there are few steps need to be completed (Refer to Appendix A). The five phases are:

Analysis phase:

In the analysis phase, a collection of data will be determined which will be needed for later development. The requirements gathered from target users must be designed and implemented at the end of the project.

Design phase:

In the design phase, the specification in developing tools is determined for both hardware and software tools. The flow and concept of game also need to be designed for guideline in the development phase.

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Development phase:

In the development phase, all the requirements and design that had been determined before will used as a guideline in the development phase. A prototype of the game will be implemented. All tools specified at the design phase will be used for development.

Quality assurance:

In quality assurance, the prototype will be tested for quality checking which essential for determining the project are at which level.

Implementation and evaluation phase:

In implementation and evaluation phase, target users play a role here which they will evaluate the effectiveness and usability of prototyping.

Please refer to Appendix A for graphical view for the DGBL – ID model.

1.5 Scope

The scope of the project will be focused on the target group that are children aged between 5 to 9 years old. Hence, mathematics modules that will be used in the game are basic learning mathematics skills. For instance, the basic mathematics skills are additional and subtraction will be developed for the children at age 5 to 9 years old, while multiplication and division will be only applied to children at the age 8 to 9 years old. The game will also introduce numbers to the children from a small number to a big number. In overall, the mathematics modules to be inserted into the games are limited to basic mathematics skill only.

1.6 Significance of project

The project is to develop a game that help children aged between 5 to 9 years old to learn mathematics and improve their basic mathematical skills. In this project also focused on developing a new environment of learning for children so that they can be more exposed to modern technology. These two combination areas will help in improving children's mathematics skills and have a stronger foundation for future high level learning. Besides encourage the student to improve their mathematics knowledge, children also be introduced to have an interest in the IT field.

1.7 Project Schedule

As explained in the methodology, the Digital Game Based Learning – Instructional Design has five phases that need to be followed for the development which are analysis, design, development, quality assurance and implementation and evaluation. According to the schedule, all tasks must be complete at each phase so that development can proceed to another phase. Refer to Appendix B for the project plan and Appendix C for Gantt chart of the project plan.

1.8 Expected outcome

The project outcomes are expected to create an interactive game to be played by children of aged between 5 to 9 years old. It also needs to encourage children to be more involve in the learning process and exposed the student to a new environment of learning. Plus, the introduction of Scratch programming throughout this development will expose children to IT field and develop their interest in IT.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter will discuss the reviews written by articles and journals authors on mathematics learning in Malaysia.

This chapter also showed the link between the subtopics with the main project which is developing an interactive mathematics game using Scratch programming. In addition, this chapter also presents the review on existing systems and proposed new system based on the comparison of three related existing applications.

2.2 Mathematics learning in Malaysia

In recent years, Ministry of Education in Malaysia has exposed and encouraged student to be more focus in Science and Mathematics subject in parallel with globalization in modern technologies. However, according to Malaysian Examination Board reported that the primary student failed the subject at more than 35% (Mahamad, Ibrahim & Mohd Taib, 2010). Although mathematics is fun to study, however, it is said that Mathematics is difficult to learn (Aziz as cited in Nordin, 2005). The research found that students faced difficulties in learning Mathematics because of the lack of ability in understanding of subject matters involving calculation, the relationship of mathematics with other subject and instruction language (Nordin, 2005).

There are few factors that might cause the problems of understanding in mathematics. Foremost, psychological attitudes toward mathematics might cause students to less interest with