

**EVOLUTION OF AN ADAPTIVE MATHEMATICS
LEARNING GAME FOR LOWER PRIMARY
STUDENTS**

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ABSTRACT

The newly coined term “courseware” was actually derived from the words “course” and “software”. The courseware that is available nowadays has been added with the adaptiveness values. These adaptive elements have been implemented by researchers in various ways. Some are using fuzzy, neural-network or even metaheuristics to implement the adaptive elements in to their courseware systems. By using these approaches, they apply the adaptiveness by optimizing the learning path. In this research, the learning path will be optimized based on the learners’ understanding level of the concept being learnt. This approach is commonly known as personalization. In this project, the Evolutionary Algorithm approach is selected as the optimization method. The EA used in this project is Genetic Programming. Instead of evolving the separate representations to the solution, Genetic Programming evolves the solution itself. Genetic Programming usually evolves computer programs instead of evolving the solution representations found in Genetic Algorithms. Nonetheless, the process of Genetic Programming is still similar to Genetic Algorithms. Apart from implementing GP into the learning system, this research utilizes the basic user interface design for designing an interface of the mathematics learning game. Since the main audience of the game is young children, some interface design elements especially suited for young children have to be taken into account. In this research, 4 experiments had been conducted to test the algorithms implemented. In comparison, experiment 2 yielded better results compared to other experiments. In experiment 2, the level was set to be fixed, while in the other experiments, the level changing parameter is set to be random. In experiments 1, 3 and 4, the findings show that the random changing level is unpredictable. Some level jumps are too high and some level jumps are too low. In general, the overall outcomes of this research demonstrate that EAs can be a viable approach in terms of implementing adaptive courseware at least in the realms of teaching mathematics to young children.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter introduces general overview and background of this project with the title Evolution of an Adaptive Mathematics Learning Game for Lower Primary Students. The main goal of this project is to design an adaptive learning game for lower primary student. The subject that will be focused in this project is mathematics lower primary school. The game only involve some basic concept in mathematics which is addition, subtraction, multiplication and division. The design of the game will be based on Malaysia's lower primary school (year 1, 2 and 3) syllabus.

Divided into 5 section, this chapter will give the explanation on project's problem background, problem statement, objectives, scope and the organization of this report.

1.2 Problem Background

In our daily life we face many problems. Problem solving skills can be enhances with critical thinking, as it helping us to build logical path and determining the relationship of ideas and patterns in the problem we faces. Learning mathematics is the way to build our critical thinking skills. This is why math is very important in our daily life. On the other hand, basic math concept is essential as it is helping us finding the great solution to the problem arises in our basic daily life such as our own or family financial. When is the earliest age to start learning math and why? As earlier as an early age of human life we start to learn math, and it is important to help us in our future study as there are so many field related to mathematics.

At school, some student learn slower than the other. The teacher will try very hard to make these student to do well as the other. Teachers came up with many solution to this problem and to make student love to learn math. 2

Making learning in fun way is not an easy work. We have to identify what group of people we are focusing on. Especially for kids, they are the expert in the world of fun. In their world, fun is an unlimited boarder. Fun is their life. Therefore, to make them having fun in learning is not an easy way.

Math is an important subject, it is essential to help us in our life. Understanding it in an early age help us in our future life, whether to future study or basic daily life activities. Kids hate learning so much but they love to play. As a connection in both learning and fun, makes the teachers, educators, researchers, government, inventor and anyone related in the field to think of the idea to help kid learn in a fun way. Currently we have seen the widely use of technology in various areas. Educational aid technology have been widen used. The educational aid software have been used a long time ago. Example of an old educational software is logo programming. Logo programming teaches it's user to learn programming while playing the game.

1.3 Problem Statement

Currently we have seen the growth of technology in various areas which is one of it is learning system or we called it as a courseware. The use of AI approach in an adaptive courseware have been in a research for many year. Traditional teaching approach that is using a fixed sequence of learning content to be learned by student (Chih Ming Chen, 2007) can lead to demotivation or expected content. Researchers have been into this area to find out the best way for student to learn more while giving less demotivation to the student. Designing a courseware using AI approach to understand student level of understanding and provide them with the appropriate resources (based on their level of understanding) may help them learning more and less demotivated. This is what we called an adaptive system, where it was designed to adapt to its user (in this case a student) to understand the user's ability and adapt to it. This is what to be design in this project. The adaptive courseware designed by researchers were using fuzzy logic, genetic algorithm and etc., yet the implementation using one of Evolutionary Computing in AI approach which is Genetic Programming is rare to be found. Most of the researchers were focusing on intelligent tutoring system, and designed it to adapt to student to determine the learning path. The goal of this project is to design an adaptivity to the learning system using AI approach. This project will not focusing on determining learning path for the student, but determining an appropriate questions based on student understanding. The game will be design to decide an appropriate questions (i.e. level) for the student based on the answer they 3

give, whether the true answer or false. To find optimal questions (next level) for the game to proceed as they play it, we are using Genetic Programming, one of the approach in Evolutionary Computing.

1.4 Objectives

The objective of this project is to:

- a) Design a simple mathematic game in Java.
- b) Design and implement an Evolutionary Algorithm (Genetic Programming) that can evolve the difficulty level of the game to adapt with the learner's performance.
- c) Test and analyze the developed adaptive learning system based on real student.

1.5 Project Scope

This project will involve students from standard 1 to standard 3 from SK Sri Tanjung Papat 1 Sandakan. The game will only covered 4 basics mathematics operation which is addition, subtraction, multiplication and division. Using Evolutionary Algorithm, this project will be designing a simple game in Java and evolve the game content to adapt with learner.

1.6 Organization of the Report

This Report divided into few chapter, all are based on what the project are attempt to achieve. Chapter 1, this chapter give an overview of the basic information of the project. This chapter included Problem Background, Problem Statement, Objective and Scope of the project.

Chapter 2 outline all the literature review related to the work of this project which is adaptive learning mathematics game for children in lower primary school. This chapter will first described the adaptive courseware at a general level and go further until specifically to the adaptive mathematics game for children in lower primary school.

Chapter 3 gives the explanation on the method to be used in the completing of this project. Included the algorithm needed and also software and hardware requirement for completing this project. In this chapter, the more information of genetic programming will be explained and how this approach is used in the game will also been explained. 4

Chapter 4 explained about system design. This chapter will explained all genetic programming setup and the design of the algorithm. The genetic programming setup include, the chromosome declaration, fitness function, crossover and mutation process, and termination condition.

Chapter 5 is the implementation of the system design in chapter 4. The implementation include all codes in the system.

Chapter 6 shows all the testing done towards the system in this project. The experiment run in 4 different environment. The experiment setup also explained here.

Chapter 7 is the conclusion of this project. Together in this chapter is the future work that might be work up for this project