

# A PROPOSED CONCEPTUAL DERIVATIVE TECHNIQUE BY USING INTERACTIVE APPLICATION GAMES

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## Abstract

Currently, the failure rate in mathematics courses is high among university students and several studies have been done in order to identify the causes of the high failure rate in this subject. According to the lecturers' feedbacks, students are basically weak in a basic foundation of mathematics and do not really understand the basic concept of differentiation. Aside from that, the problem can be seen among students are; the difficulty in identifying the type of function in differentiation and in identifying that suitable method to solve a particular problem. There are three methods included in differentiation; the chain rule, product rule and quotient rule. This study aims to introduce the interactive application games that can help students to improve their skills in differentiation and obtain more understanding about the concept of differentiation. We only focus based on the basic function of composite function, product of two function and rational function. By using this application, it can help students to recognize the types of function and at the same times the rules of differentiation that can be used before they solve the problem.

Keywords: Derivative; Chain rule; Product rule; Quotient rule; Composite function; Rational function

## 1.0 INTRODUCTION

Teaching and learning of calculus has been the subject of much debate and research during the last decade because of the poor performance in mathematics courses especially in calculus subject. In calculus, the derivative is a root concept and it is the most difficult topic for students because it requires

understanding of concepts such as function, differentiation, quotient and limit [1, 2]. One of the most essential and fundamental concepts in calculus is the concept of function. Calculus requires a high level of conceptual understanding but many students struggle to make sense of derivation itself [3].

Derivation is an important concept in mathematics for undergraduate students in university in order to learn other concepts in the different fields of studies [4-6]. Differentiation is the algebraic method of finding the derivative for a function at any point. The reason for students to have difficulties to learn and understand the concept of derivation is because of their lack of conceptual understanding [6]. Many students have difficulty seeing a tangent as the limiting case of a secant [7, 8] and understanding what a limit is [9, 10]. The algebraic manipulations required in differentiation from first principles, often obscure the process and principals involved. Most of the students have to worry about factoring cubic equations and simplifying rational polynomials, as well as to understand the fundamental aspect of determining the gradient of a secant as it approaches a tangent [7, 8]

Meredyth, Russell, Blackwood, Thomas, and Wise [11] introduced students the technique of differentiation by using spreadsheets. Cheung and Slavin [12] have concluded that educational technology applications produce a positive and small significant effect on mathematics. Handheld technology is used in mathematics education in many ways such as using calculators, laptops, tablets and smartphones [13, 14].

Frequently-cited arguments held by these researchers for using computer game in education are; computer games can invoke intense engagement in learners [15, 16], computer games can encourage active learning or learning by doing [17], empirical evidence exists that games can be effective tools for enhancing learning and understanding of complex subject matter [18], and computer games can foster collaboration among learners [19].

Yusuff [20] says that, research on the way of the techniques in teaching mathematics and learning in mathematics at the university level should always be carried out. According to the past research, students lack in fundamental of mathematics and basic concept of differentiation.

There are some methods being introduced to support students to overcome their difficulties in learning the concept of derivation involving function. For this study, a derivative game for computer software application is proposed in identifying the type of differentiation according to functions. Thus, it can help student to determine the suitable method used in differentiation according to the types of functions.

## 2.0 METHODOLOGY

For this study, students from two campuses of Universiti Teknologi MARA (UiTM Caw Perak Kampus Tapah and UiTM Caw Johor Kampus Pasir Gudang) are selected as a sample. Those students have taken Calculus subject in where the derivative is one of the

key concepts in this course during their first year of Diploma. Definition of differentiation, derivatives of composite function, derivative of a product of two functions, and the derivative of quotient of two functions are covered in the first chapter of Calculus. The aim of this study is to give better understanding on how to choose the right method of differentiation related to rules and functions by using interactive derivative game computer software application.

To achieve the stated goal, these students will have to experience learning derivation through this computer application after the classroom session. Therefore, the use of computers in education can be fully utilized as a new technological support for the visualization of concepts through computer-generated virtual representations, Brandt [21].

## 3.0 DISCUSSION

### The Conceptual Model

A proposed conceptual model for an interactive derivative game computer software application as Figure 1:

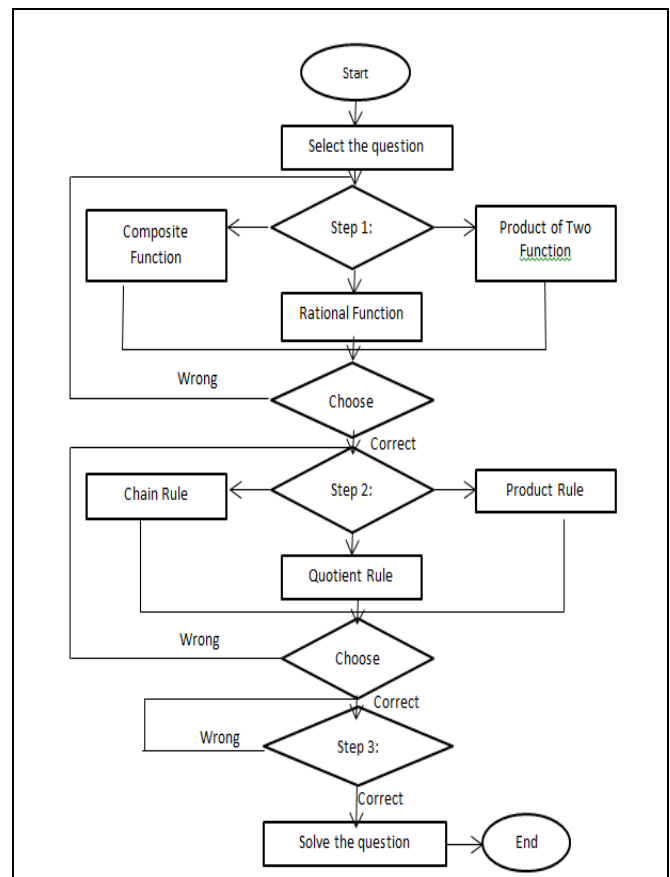


Fig. 1. Conceptual model for an interactive derivative game computer software application.

In this research, the conceptual understanding of the basic differentiation related to rules and functions is applied in the interactive derivative game computer application. This computer application establishes an alternative approach for motivating students towards mathematics specifically in derivation.

Step one starts with selecting question of identifying the function. There are three functions include Product of two function, Rational function, and Composite function. Students should answer correctly for this step to continue to step two. In step two, students should identify which rules of derivative regarding to the function. It refers to Product rule, Quotient rule, and Chain rule. The last step is, students should identify the value of  $x$  and  $y$  then differentiates it according to rules of differentiation given.

### Interactive Derivative Game

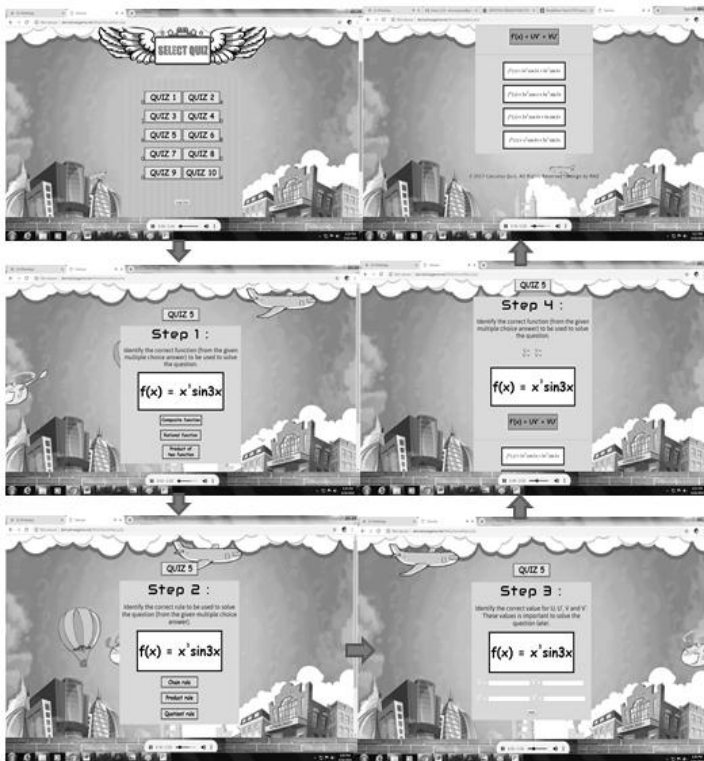


Fig. 2. The interface of interactive derivative game application.

Figure 2 shows an educational software component, specializing in derivation related to rules of differentiation and types of functions concepts. Firstly, student is required to login to this system. Each student needs to insert username, matric number and password before they can start the quizzes. For each quiz, they are required to follow all the four steps until the end of the online quiz session and marks will be also saved for analysis purposes. Some of the steps include, identifying the types of functions and the rules

applied related to each functions. These steps will help students in examining the right method of differentiation according to the conceptual understanding of the function in derivative. There are total of 30 questions which include logarithmic, trigonometric, algebraic, and exponential functions that they already learned in Calculus subject.

It is presented through applications that conceived an interactive, informative and functional oriented learning concept towards students. The architecture of this computer software application integrates interaction process learning through an interactive interface, easy access mechanisms including content, layout and appearance.

Interactive is a major component in this application development. It is considered as a bidirectional interaction between learner and computer application in order to retrieve rich multimedia content such as audio or animations.

This computer application learning environment is defined as a collaborative learning for the generation through mathematical knowledge. It has been designed to provide support for learner-learning object interaction. The environment model is organized with fully independent software system. This allows us to extend the functionality of the system without affecting the entire model, in the sense that new elements can be added or modified when new pedagogical or technological elements are available.

### 4.0 CONCLUSION

The interactive derivative game for computer software application is intended to provide learners with a personalized work-space learning, in which they enjoy the freedom to explore, learn and understand the concept of differentiation and function according the syllabus in Calculus. Therefore, this application is designed so that learners can adapt the learning environment interface in accordance with their different learning styles. This computer software application is also viewed as an aid in derivative learning and it could act as an effective motivational tool for students.

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