

Using Excel and GSP as computer-based mathematical tools to assist secondary students setting up models with exponential and cosine functions.

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Abstract

Although Vietnamese secondary students are quite good in solving problems with given mathematical models or partial modelling, but they feel difficult in creating their own mathematical models to solve non-routine realistic problems. Influenced by a focus on modelling with computer-based mathematical tools (CBMT), we will try to describe and give some situations that involved Vietnamese students in setting up and using models to solve real-world problems. We introduced the cycle of modelling with exponential and sinusoidal functions by using Microsoft Excel (2007) and GSP (version 5) as computer-based mathematical tools. In this article, we use Microsoft Excel as an automatically CBMT to set up exponential model, and the GSP as dynamically CBMT to make sinusoidal model. The results showed that setting up models with CBMT created an active learning environment in the mathematics classrooms and secondary students to construct a specific cycle with some concrete steps to solve real-life problems.

1. Introduction

Secondary Vietnamese students highly appreciate their learning mathematics in schools. They try their best to learn mathematics under the pressure of family and society. Most of the students who participated in the PISA 2012, 2015 surveys (Program for International Student Assessment) agreed the following statement “*it is worth making an effort in learning mathematics in schools, because equipped mathematical concepts and skills will help us to perform well in our desired professions later on in life*” ([6]). Vietnamese students are proficient in core mathematical concepts and skills, the main reason is students need to study hard to overcome the summative assessments in an educational environment focused too much on “*learning to take examination*” ([9]).

A visible role for mathematical tools, including technology is described in the PISA 2021 framework. The definition of mathematical literacy explicitly includes the use of mathematical tools (MT). These tools include a variety of *physical* and *digital* equipment, software and calculation devices. Computer-based mathematical tools (CBMT) are in common use in workplaces of the 21st century, and will be increasingly more prevalent as the century progresses both in the workplace and in society generally. The nature of day-to-day and work-related problems and the demands on individuals to be able to employ mathematical reasoning (both deductive and inductive) in situations where computational tools are present has expanded with these new opportunities – creating enhanced expectations for mathematical literacy ([7]). Computer-assisted instruction programs are considered a way to improve learning outcomes of students. However, little is known about the schools that implement such programs as well as the effectiveness of similar information and communication technology programs ([10]).

The way in which we view mathematical tools is shown in Figure 1.

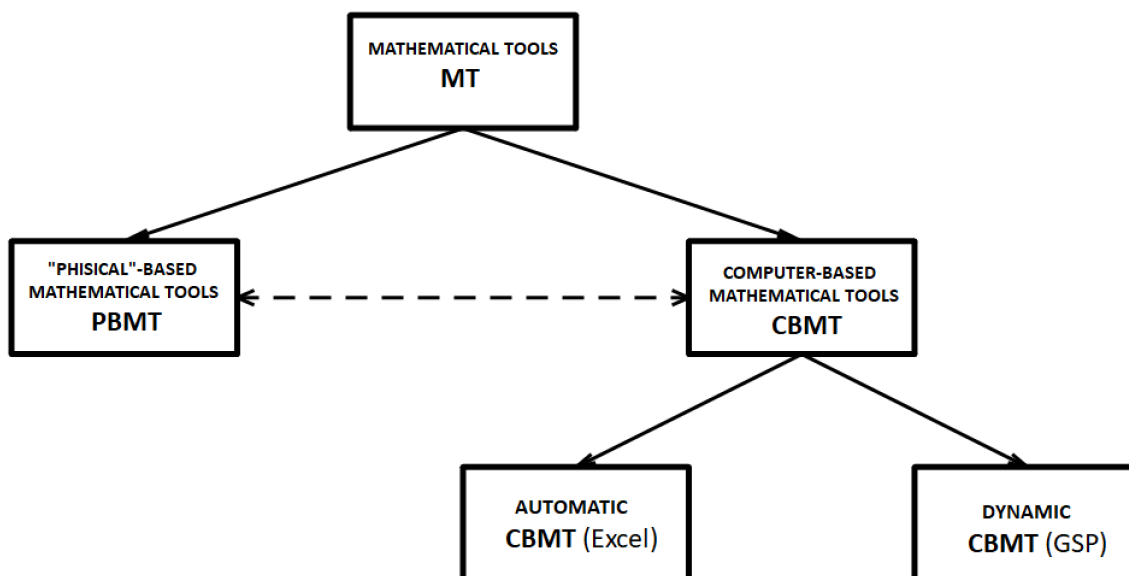


Figure 1. *The categories of mathematical tools including PBMT & CBMT.*

We consider an automatic CBMT as a CBMT that gives the mathematical models automatically if we input properly data and predict appropriately the models, and in a dynamic CBMT, we can drag the sliders dynamically to get the mathematical models.

In this article, we see Microsoft Office Excel (2007, [3]) as an automatic CBMT to set up an exponential model, and the Geometer's Sketchpad (GSP, Version 5, [4]) as a dynamic CBMT to set up a sinusoidal model. In the present study, a case study design was adopted as this design is appropriate for in-depth investigation of student mathematical modelling activity. This design has been argued to be suitable for investigations involving cognitive processes ([2]). There were 124 Grade 12 high school students (17-18 years old) from three classes who participated in this pilot study. They had learnt the derivative and integral of real functions, and the relationship between speed and distance of an article. They can use Microsoft Excel and dynamic software to draw the graphs of functions. The school was located in Hue City, a regional city in Vietnam ([10]).

2. Modelling with computer-based mathematical tools

In this article, a mathematical model is an exponential or function that describes a real-world problem. Modelling is the process of finding such functions with the assistance of computer-based mathematical tools. They bring the real world into the computer environment where we need to arrange the data, make and use a model. The way in which we view the process is shown in Figure 2.