

# Research on LiveMath

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## What is LiveMath?

*LiveMath* is a computer algebra system (CAS) that can perform symbolic manipulations such as factorisation, differentiation and integration. What sets it apart from other CAS is the ability of *LiveMath* to effect changes immediately: when the user changes the value of a variable, any expressions, equations and graphs that are related or linked to this variable will also change automatically and instantaneously.

## Why use LiveMath?

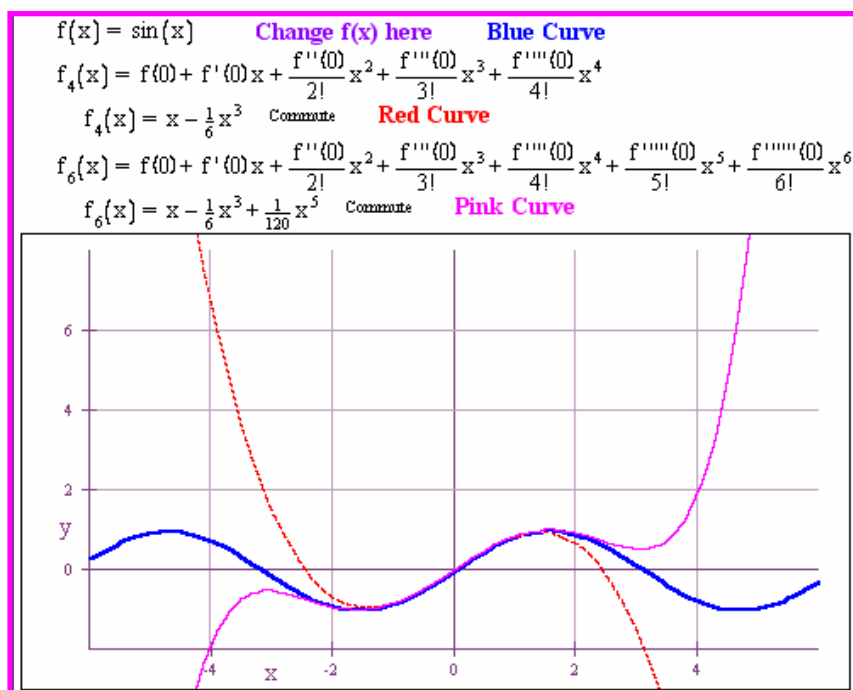
Mathematicians, scientists and engineers usually use a CAS to solve complicated problems. But students are still expected to perform symbolic manipulations by hand. Therefore, we exploit the power of the interactive feature of *LiveMath* to guide students to explore mathematical concepts. All the students need to do is to change the values of some variables and they can observe the effects of these on the algebraic expressions, equations or graphs immediately.

## An Example of How to Use LiveMath at A-Level

Many students do not understand how the Maclaurin's expansion of a function works. For example, how can a trigonometric function, such as  $\sin x$ , be equal to a polynomial, namely,

$$x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots ?$$

A LiveMath template (see diagram on the right) can be set up to guide students to explore the relationships between the function and the first few terms. E.g. the more terms we have, the better the approximation and why; and the approximation is better around  $x = 0$  and why. The students can then change the function to  $\cos x$  or  $e^x$ , and the Maclaurin's expansion and the graph will change immediately, thus allowing the students to continue their exploration with ease.



## Research with Hwa Chong Institution

I supervised two teachers from the college section from 2005 to 2006 to investigate the effect of exploratory computer-based learning on the students' conceptual knowledge, procedural skills and affective variables. One of the teachers conducted a few lessons using *LiveMath* to guide students in the experimental class to explore certain mathematical concepts. The findings were presented in ERAS Conference in Singapore in 2006 (please refer to conference proceedings).