

# MCL<sup>1</sup> is "catalyst" of promoting the comprehensive development of students under the new curriculum

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**Abstract:** *After two years' use of graphing calculators Hp39gs, MCL gradually has stimulated the students' interest in learning, enriched students' learning methods and improved their capability of learning. This paper aims to argue that MCL does promote the overall development of students at all levels through typical and specific cases from the three aspects under the new curriculum, and mainly reflects in how: (1) MCL makes those advanced math learners find a helping hand. (2) MCL helps those who are weak in math to find self-confidence; (3) MCL helps those who have no interest in mathematics students to find a starting point.*

The new mathematical curriculum advocates the study style that students are active and are daring to explore. It promotes information technology and the organic integration of course content (e.g. the algorithm into all relevant parts of the mathematics curriculum), the basic principles of integration is beneficial to students understanding of the nature of mathematics.

Teachers should not limit students' mathematical learning activities to receiving, memorizing, imitation and practice, but rather play the role of inspiring students' independence, such as self-exploration, hands-on practice, cooperation, communication, self-learning and other ways of mathematical learning. The effective implementation of handheld technology and middle school mathematics teaching enriches the content of mathematics teaching, and promotes the teaching, learning and other aspects of inquiry.

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<sup>1</sup> MCL is a handheld mobile lab. It can help students to explore mathematics and self-learning tool independently.

From an abstract point of view, MCL provides opportunities for independent learning and inquiry, inspires students to create the passion and inspiration, and contributes to the quality of student of scientific research and scientific development of the Spirit; From the specific point of view, MCL makes those advanced math learners find a helping hand, helps those who are weak in math to find self-confidence, and those who have no interest in mathematics students to find a starting point.

Since September 2008, we have been using HP39gs graphic calculator for more than two years in our school. When we first started using it, we got some challenges. Some head teachers thought it was a game machine that would make students get addicted to. Most of the physics and chemistry teachers even asked me personally whether that was a calculator. They thought students were not quite good at calculating, so this machine would make them rely on it too much. I always reminded myself of applying “3Y” principle in my teaching. In my practice in the MCL course, I realized that our math classes have been more active and interesting. My students were most likely motivated by MCL on learning basic math knowledge and improving their awareness of applying and connecting math with other subjects. MCL course has aroused my students’ curiosity to know math, to bring new ideas to math learning, and to realize the scientific and culture value of math. MCL course opens my students’ eyes not only in math learning but also in their life time learning.

### **一、MCL makes those advanced math learners find a helping hand.**

**Case 1** I remember in 2008, when I first met the graphing calculator, I did not know whether I could not use it or not? Can it be applied to my teaching? If it could be used, whether it could be used effectively? What I worried about most was what and how I could teach the students by using it? Especially how to use “3Y” (In Chinese, that is “everyone has, often used, appropriate use”) well? I asked myself many times. At that moment, I talked about with the smartest math class representative –Wang Ming in the first place, thinking that if he could figure out first, and then taught the whole class, and meantime he also could give me a hand and became the most successful assistant of mine.

With a plan started like this, I taught some simple operations to Wang Ming, such as: how to switch it on or off? How to enter the function analytic? How to draw functions, and so on. Of course, these were the most basic operations that he could master. I asked him if he was interested in it. He answered: “very much.” I showed him the instructions of the graphing calculator, and let him take the time to look it at, and told him the graphing calculator can also be programmed, set the alarm, and gave us good music. I also told the truth that he would first study the graphing calculator instead of me. A week later, when I walked into the room, I suddenly heard the faint

sound of music, the "Happy Birthday" song. I laughed and asked: "What sound?" asked I. One answered, "Ms. Tian, It is mine." "How did you find the function?" I asked. He answered, "Wang Ming taught us." He answered proudly. Another student also ran to me and said happily: "Ms. Tian, look! The 'non-mainstream' we drew!" I said excitedly, "Very beautiful! I'm proud of both of you" In this way, gradually Wang Ming became a little mathematics teacher of our class.

In 2009, in Beijing Normal University, China's first winter session of Hp was held. It is much honored that I was invited to a workshop to demonstrate our work and other test area to exchange teaching teachers how to use graphing calculator and How to use more of its programming content. Successful completion of this report thanks to our class of "small teacher"---- Wang Ming, he helped me go the research with the basic procedures and precautions of programs before a week. I am very proud of his achievements in programming as his math teacher. The following is the 2010 "Fibonacci series" nature of the three procedures by Wang Ming.

Programming 1:

<pre> RABBIT PROGRAM INPUT R; ;"R"; ;0: ERASE: 1▶A:1▶B:1▶I: IF R&lt;2 THEN DISP 1;1: ELSE </pre>	<pre> RABBIT PROGRAM IF (R MOD 2)==0 THEN R/2▶C: WHILE I&lt;C REPEAT A+B▶A:A+B▶B: I+1▶I:END: DISP 1;B: </pre>	<pre> RABBIT PROGRAM ELSE (R+1)/2▶C: WHILE I&lt;C REPEAT A+B▶A:A+B▶B: I+1▶I: END: </pre>
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Programming 2:

(1) Continued fraction representation of the program calculated the number of golden

$$\frac{1}{\Phi} = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \dots}}}}$$

<pre> SHULIE PROGRAM END: 1/A▶A: DISP 1;A:FREEZE: </pre>	<pre> SHULIE PROGRAM INPUT B; ;"B"; ;0: ERASE: 1▶I:1▶A: WHILE I&lt;B REPEAT (1+1/A)▶A: (I+1)▶I: </pre>	<p>B: <input type="text" value="0"/></p> <p>25</p> <p>[CANCEL] [OK]</p>
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(Program displays the time when the loop 25 times, the value of 0.61803398878)

(2) Calculate the square root of the golden section method that the number of procedures.

$$\Phi = \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \dots}}}}}$$



(Program displays when the loop 25 times, the value 1.61803398875, through the comparison between the two procedures with the same.)

**Case 2** The whole class was set off to learn the climax of graphing calculator by Wang Ming, they used it during recess, lunch and evening time before going to bed in their dormitories, and they used it by themselves, or in a group of two, or a group of several people. Meantime, they immediately fell for the programming, particularly boys, and the most outstanding ones are Zhang Bing and Zhao Yang. As for the importance of the periodic table of chemical-based graphing calculator sensing and HP39gs practicality, they wrote a paper named, "produced by chemical periodic table HP39gs graphing calculator." that is to say, once the students touch the sensing key, the corresponding number of atoms of elements and proton number information will be displayed. Divided into four main programs:

(1) Interface Design:

```
-4→Xmin: 5→Xmax:
-1.5→Ymin: 2→Ymax:
FOR X=4 TO 4.5 STEP 0.5;
FOR Y=-1 TO 0.5 STEP 0.5;
DISPLAY X; Y; 1; "■": END: END:
```

(2) Induction procedures are as follows keys:

```
DISPLAY PANDOM;PANDOM; 1; "*"
DO
  GETKEY A:
CASE
  IF A=25.1 THEN
    Y+1→Y:
  DISPLAY X;Y; "*"
END
  IF A=35.1 THEN
    Y-1→Y:
  DISPLAY X; Y; "*"
END
  IF A=34.1 THEN
    X-1→X:
```

```

DISPLAY X; Y; "*"
END
  IF A=36.1 THEN
    X+1→X:
  DISPLAY X; Y; "*"
  END
END
UNTIL A=105.1 END:

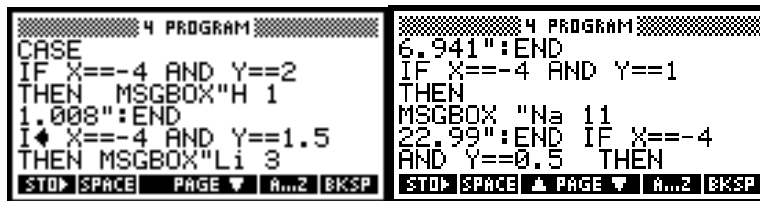
```

(3) Output:

```

CASE
  IF X=-4 AND Y=2
  THEN MAGSBOX"H 1 1.008": END
  .....
  .....
  IF X=4.5 AND Y=-0.5
  THEN MAGBOX "Rn 86 222": END
END:

```

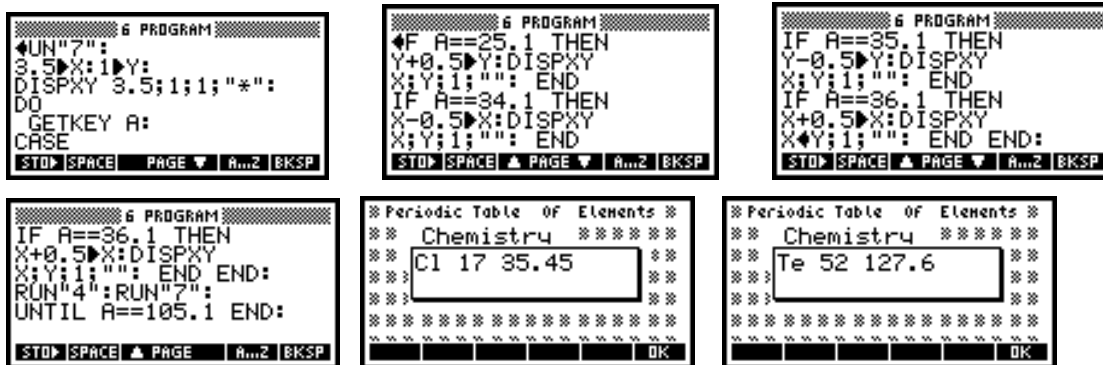


(4) Induction procedures embedded in the keys of two subprograms:

```

RUN"7":
3.5→X:1→Y:
DISPLAY X;Y; 1; "*"
DO
  GEKEY A:
  .....
  .....
  END
END:
RUN"4":
RUN"7":
UNTIL A=105.1 END:

```



In order to give greater convenience to students, listening to the suggestions, they improve the program; the basic procedure is as follows:

INPUT M; "M" ; ; 0:

CASE

IF M==1 THEN

MSGBOX"H 1 1.008": END

IF M==2 THEN

MSGBOX "He 2 4.003": END

.....

.....

IF M==86 THEN

MSGBOX"RN 86 222": END

END;

Afterwards, in the exhibition of the second national HP Summer Camp, a student from FuJian edited this paper which got good reviews from experts and teachers. He was awarded with Creativity Award.

Apparently, MCL course is not only a course which improves the basic math skills or widens students' views in math learning, but also a course which benefits students in developing creativity, exploration spirit, and other great qualities life time

## 二、MCL helps those who are weak in math to find self-confidence

**Case 3** Although Zhang Lin doesn't have a very high score in maths, he has a strong

will. He spends his spare time studying the nature and the image of  $y = ax + \frac{b}{x} (x \neq 0)$

, writing an essay of more than 10 pages! The article "The inquiry of Function caused by the check mark inquiry". Although he was not awarded in the competition of student paper, but I think this event benefited him far better than a "certificate". He did not give up, and still made great efforts to study mathematical problems with a graphing calculator. Hard work pays off! Because of his outstanding performance, he

attended the first session of the National "HP Cup winter voyage of discovery," on behalf of our school. Finally, their team won the third prize of the competition. Since then, he has gradually made greater progress in maths, and also gained better development of many other aspects.

<b>Analytic function</b>	$y = ax + \frac{b}{x} (a > 0, b > 0)$	$y = ax + \frac{b}{x} (a < 0, b < 0)$
<b>Functions images</b>		
<b>Domain</b>	$\{x   x \neq 0\}$	$\{x   x \neq 0\}$
<b>Range</b>	$\{y   y \leq -2\sqrt{ab} \text{ or } y \geq 2\sqrt{ab}\}$	$\{y   y \leq -2\sqrt{ab} \text{ or } y \geq 2\sqrt{ab}\}$
<b>Monotonicity</b>	$]-\infty, -\sqrt{\frac{b}{a}}]$ and $[\sqrt{\frac{b}{a}}, +\infty)$ are ascending	and are ascending $[\sqrt{\frac{b}{a}}, 0)$ and $(0, \sqrt{\frac{b}{a}}]$
	and are decreasing $[-\sqrt{\frac{b}{a}}, 0)$ and $(0, \sqrt{\frac{b}{a}}]$	$[-\sqrt{\frac{b}{a}}, -\infty)$ and $[-\sqrt{\frac{b}{a}}, -\infty)$ are decreasing
<b>Parity</b>	<b>odd function</b>	<b>odd function</b>
<b>Analytic function</b>	$y = ax + \frac{b}{x} (a > 0, b < 0)$	$y = ax + \frac{b}{x} (a < 0, b > 0)$
<b>Functions images</b>		
<b>Domain</b>	$\{x   x \neq 0\}$	$\{x   x \neq 0\}$
<b>Range</b>	$\{y   y \neq 0\}$	$\{y   y \neq 0\}$
<b>Monotonicity</b>	$]-\infty, 0)$ and $(0, +\infty)$ are decreasing	$]-\infty, 0)$ and $(0, +\infty)$ are decreasing
	<b>No decreasing</b>	<b>No ascending</b>
<b>Parity</b>	<b>odd function</b>	<b>odd function</b>
①	<b>Domain of</b> $y = ax + \frac{b}{x}$ is $\{x   x \neq 0\}$	

②	$ab > 0$ , Range is $\{y \mid y \leq -2\sqrt{ab} \text{ or } y \geq 2\sqrt{ab}\}$
	$ab < 0$ , Range is $\{y \mid y \neq 0\}$
③	$ab > 0$ , Function has the intersection about the x axis and the y axis
	$ab < 0$ , Function has the intersection about the x axis but not the y axis
④	$ab > 0$ , Each quadrant has a change interval
	$ab < 0$ , Each quadrant has a change interval and same monotonicity
⑤	$ab > 0$ , Monotonicity is opposite in $a > 0, b > 0$ and $a < 0, b < 0$
	$ab < 0$ , Monotonicity is opposite in $a > 0, b < 0$ and $a < 0, b > 0$
⑥	Images of $y = ax + \frac{b}{x} (a > 0, b > 0)$ and $y = ax + \frac{b}{x} (a < 0, b < 0)$ is on the y-axis symmetry
	Images of $y = ax + \frac{b}{x} (a > 0, b < 0)$ and $y = ax + \frac{b}{x} (a < 0, b > 0)$ is on the y-axis symmetry
⑦	$y = ax + \frac{b}{x} (x \neq 0)$ is odd function, nothing about a, b

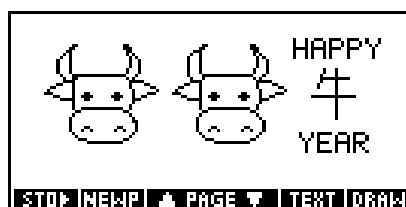
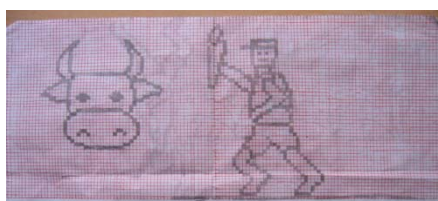
**Case 4** Xu Jia was an active student who loved drawing, especially using graphic calculator to make his own works. In 2009, he attended the first “HP Discovery Winter Camp” where he made his own graphic design called The Amazing 2008. However, he was not an easy boy to deal with. He was a resident student who can only go out every other week. There was one time he climbed over the walls in order to hang out with friends at internet bars outside the school. He was finally found by the person who was in charge at the school.

A decision has been made to expel him after this incident. His head teacher was so worried when she heard about this punishment. No matter what, he was still considered as a good student with potential ability to achieve higher goals. It would be a waste if he got expelled just for this incident. He always had his own points of view which made him too stubborn to listen to others’ opinions. One day, his head teacher asked me to do her a big favor to talk to this student who has changed a lot better since he joined the MCL course.

I started my conversation with him asking about his life and study instead of pointing against this issue. I asked him, “Do you still like graphic calculator? Do you still want to attend the MCL course?” He said, “Sure, I still like it. It helped me to solve some tough problems. It makes the most advantage of my skills. I make amazing graphics with it.” In a moment, he added, “Ms. Tian, please believe me that I



will make great effort from now on. I won't cause any trouble anymore. I'll keep my words!" From then on, he seriously acted up to his promise. He has grown up to be an outstanding student who kept good behavior as well as high grades in all subjects. His improvement was like the graphic shown above. He also invented some programs which connect individual graphics to make animation. The following is his work.



### 三、MCL helps those who have no interest in mathematics students to find a starting point.

The first principle of new curriculum is to serve the students. Students' personality and individuality should be respected in the teaching process. Through learning, students who have difficulty in learning feel the fun of learning and realize that mathematics comes from life, and serves for life. As students explore the outcome of an issue, it will enable students to have more confidence, experience their own values.

Case 5 As a student, Zhang Qi is a little shy and introverted one. He does not follow conventional thinking when he thinks about something. So we should always care about such problems in his assignments, for example, he is not good at essential knowledge. New knowledge can't be taken in well and he also lacks the ability of logical thinking. All the problems made his scores lower than the others. That's why teachers often pay more attention to him, However, after we use graphing calculators for more than two years, he solves a lot of doubtful problems in his mind and change some strange ideas. Now he has made great progress in learning, and he even "challenge" me sometimes. Of course, other disciplines also will improve his performance, personality and change his step by step. Parents are so glad that they show me a lot of thanks.

In the process, MCL passes the mathematics learning content, riches learning resources of mathematics, and promotes the links between mathematics and other disciplines by the most efficient way. Certainly, integrated development of students cannot be accomplished in one single day. It has to be a systematic procedure. In our teaching practice, we have to follow proper steps to keep us on the right track the entire time. We learn from our success and failure. For instant, in order to encourage students to create more original ideas, we practice open-ended mathematical problems.

With “Thematic Study”, our students get to explore and solve problems all by themselves. The integration of new technology and course design constitutes a great and unique opportunity for students’ development.

## References

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