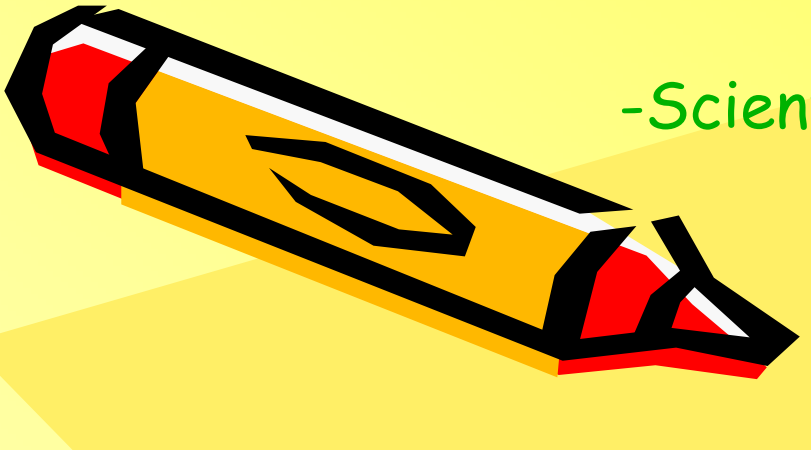


The Next Wave
-Scientific Calculator for Primary School
Conference

Primary Math, Calculator and I
- some thoughts on teaching and learning with calculator

Dr Victor Tan
Department of Mathematics
National University of Singapore

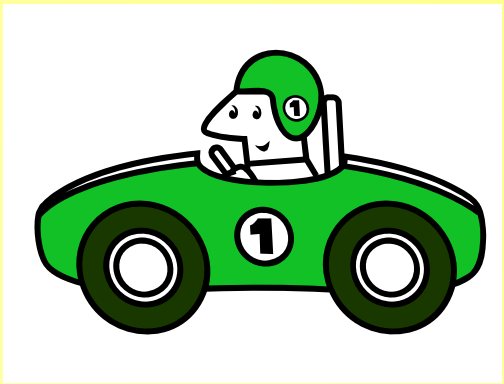
Primary Math and I

- I am teaching university math
- I am not into math education
- My daughter is in K1
- I have been conducting enrichment classes for P5 and P6 students

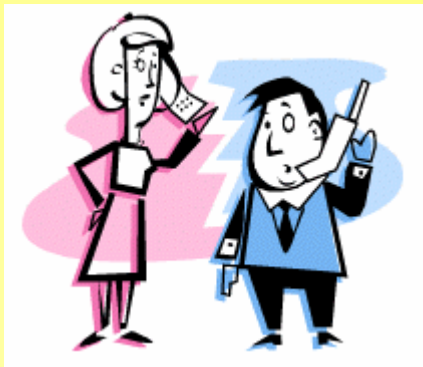
Calculator and I

- I seldom use my calculator
- Use excel file as "calculator"
- Make sure my students bring the allowed calculators to exam
- Decide whether to let students use Graphing calculators
- I use IT in my teaching

Human-beings tend to be lazy



Technologies improve our lives and works if used properly



But over-dependent on technologies may not be a good thing

What will students miss?

- if they are over-dependent on calculator

- to make observation
- to think
- to acquire the skills of solving problems
- to see the beauty of mathematics

My Primary Enrichment Class

- Arithmetic
- Keep away their calculators
- Exercise their brains

Example 1

Tell me the answers in 2 seconds

$$66 + 47 + 34 + 53 = 200$$

100 (over 47 + 34)

100 (over 66 + 47)

Human brains are more powerful than calculators

Example 2

$25 \times 32 \times 125 = 100000$

$25 \times 4 \times 8 \times 125$

$100 \qquad 1000$

Breaking and pairing up

Example 3

$$199999 + 19999 + 1999 + 199 + 19$$
$$+1 \qquad +1 \qquad +1 \qquad +1 \qquad +1$$
$$200000 + 20000 + 2000 + 200 + 20$$
$$222220 - 5 = 222215$$

Borrow and return

Keep away your calculator

66 + 47 + 34 + 53

25 x 32 x 125

199999 + 19999 + 1999 + 199 + 19

Is it really necessary?

For PSLE: No

For learning math: Yes

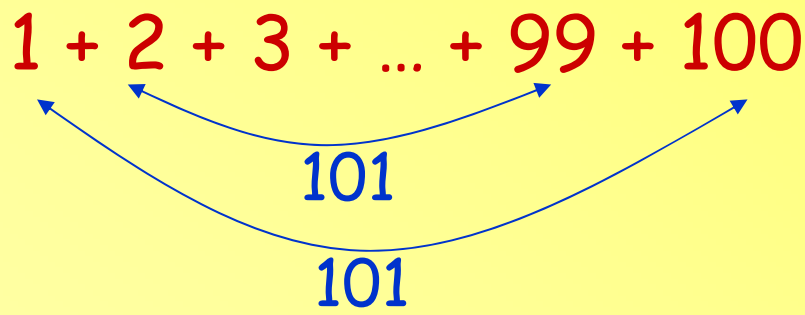
Example 3 (revisited)

$$\underbrace{199\ldots9}_{100\text{ digits}} + \underbrace{199\ldots9}_{99\text{ digits}} + \ldots + 199 + 19$$

Beyond the capability of the calculator

Borrow and return

Example 4



50 pairs of 101: $50 \times 101 = 5050$

key in 100 numbers one at a time

Example 5

Express the quotient in lowest term

transfer 1 over

$$\frac{1998 + 1999 + 2000}{1997 + 1998 + 1999 + 2000 + 2001} = \frac{3 \times 1999}{5 \times 1999}$$

transfer 1 over

transfer 2 over

discover the properties of numbers and operations

Trial and Error

- The kids are good at pressing buttons
- Calculator makes it easy to do trial and error
- Minimal thinking

Example 6

What is the digit B ?

			B	2
x			7	B
6	3	9		6

Guessing without thinking:
try B = 1, 2, 3, 4, …

Guessing with thinking:
only try B = 3 and 8

Example 7

Find the value of A.

$5\times5 \quad 7\times7 \quad 9\times9 \qquad A = 5\times7\times9 = 315$

$25 \times 49 \times 81 = A \times A$

$99225 \xrightarrow{\text{square-root}} 315$

$2\times2\times2\times2 \quad 3\times3\times3\times3 \quad 4\times4\times4\times4 \qquad B = 2\times3\times4 = 24$

$16 \times 81 \times 256 = B \times B \times B \times B$

$331776 \xrightarrow{\text{trial-and-error}} ?$

First Brain, then fingers

- Educate your students to always think first, before using the calculator
- Give your students problems that cannot be solved efficiently without thinking

Example 7 (revisited)

$$\underbrace{16 \times 81 \times 256}_{331776} = B \times B \times B \times B$$

$331776 \xrightarrow{\text{trial-and-error}} ?$

Observe:

1. $20 \times 20 \times 20 \times 20 = 16000$
2. $30 \times 30 \times 30 \times 30 = 81000$

possible values for B: 21, 22, 23, …, 29

Example 8

Put in the boxes digits 1, 2, 3, 4, 5
such that the product is the greatest.

	4 or 5	2 or 3	1
x		4 or 5	2 or 3

	4	2	1
x		5	3

22313

	4	3	1
x		5	2

22412

	5	2	1
x		4	3

22403

	5	3	1
x		4	2

22302

Calculator for experiments

- Discover nice patterns in numbers
- Explore large numbers
- Calculators can help with the exploration

Example 9

What is $\underbrace{11\ldots1}_{10\text{ digits}}\underbrace{22\ldots2}_{10\text{ digits}} \div \underbrace{33\ldots3}_{10\text{ digits}}$?

Ans: $\underbrace{33\ldots3}_{9\text{ digits}}4$

$12 \div 3 = 4$

$1122 \div 33 = 34$

$111222 \div 333 = 334$

$11112222 \div 3333 = 3334$

Example 10

Last digits of products of 4

$4 \times 4 = 16$

$4 \times 4 \times 4 = 64$

$4 \times 4 \times 4 \times 4 = 256$

$4 \times 4 \times 4 \times 4 \times 4 = 1024$

odd copies of 4: last digit is 4

even copies of 4: last digit is 6

$14 \times 14 = 196$

$14 \times 14 \times 14 = 2744$

:

$24 \times 24 = 576$

$24 \times 24 \times 24 = 13824$

:

Example 11

Remainders when 3 divides 111…1

1 ÷ 3 remainder is 1

11 ÷ 3 remainder is 2

111 ÷ 3 remainder is 0

1111 ÷ 3 remainder is 1

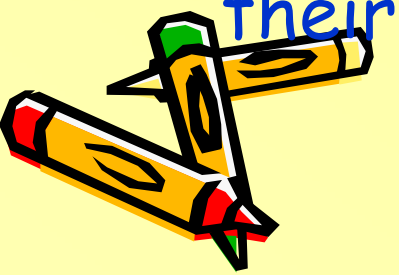
11111 ÷ 3 remainder is 2

111111 ÷ 3 remainder is 0

Concluding remarks

When you set a problem:

- don't set it so that the answer can be obtained from the calculator easily
- don't set it so that calculator cannot be used
- set it in such a way that it requires the students to observe and think before using their calculators



Concluding remarks

With the introduction of calculators,

- focus is not on doing computation fast and accurate
- focus is more on thinking and reasoning
- pass the message to your students

Thank you for your attention