

The Tenth International Conference on Technology in Mathematics Teaching

Re-looking at the Impact of Technology on the Development of Mathematics Curriculum

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5 July 2011, University of Portsmouth, UK

Outline

1. Introduction
2. Research Questions and Purposes
3. Conceptualisation and methodology
4. Findings
5. Concluding remarks

1. Introduction

Why this study

APEC Thailand Conference Six Principles for Textbook Development (Fan, March 2010):

- curriculum principle
- discipline principle
- pedagogy principle
- technology principle
- context principle
- presentation principle

Technology Principle

About 15 years ago, I criticized, with good intention, that mathematics education including textbooks in China was largely isolated from modern technology and there was virtually no existence of technology in the mathematics textbooks (Fan, 1995). I must say that this criticism is no longer valid, as China has made dramatic progress in this aspect in the new wave of curriculum reform, most visibly in the new textbooks developed. In Singapore, much progress has also been made over the last decade or so.

(Fan, 2010)

2. Research Questions and Purposes

Research Questions

How has technology been used and reflected in the current mathematics textbooks in China and Singapore? Also, what progress can be observed in this area over the last 15 or so years?

Research purposes

- Examine and hence document the use and impact of technology on the development of mathematics curriculum, and
- Discuss and explore the future direction of using technology in curriculum development.

(Note: it is not an evaluation of textbooks)

3. Conceptualisation and methodology

What is digital technology in this study?

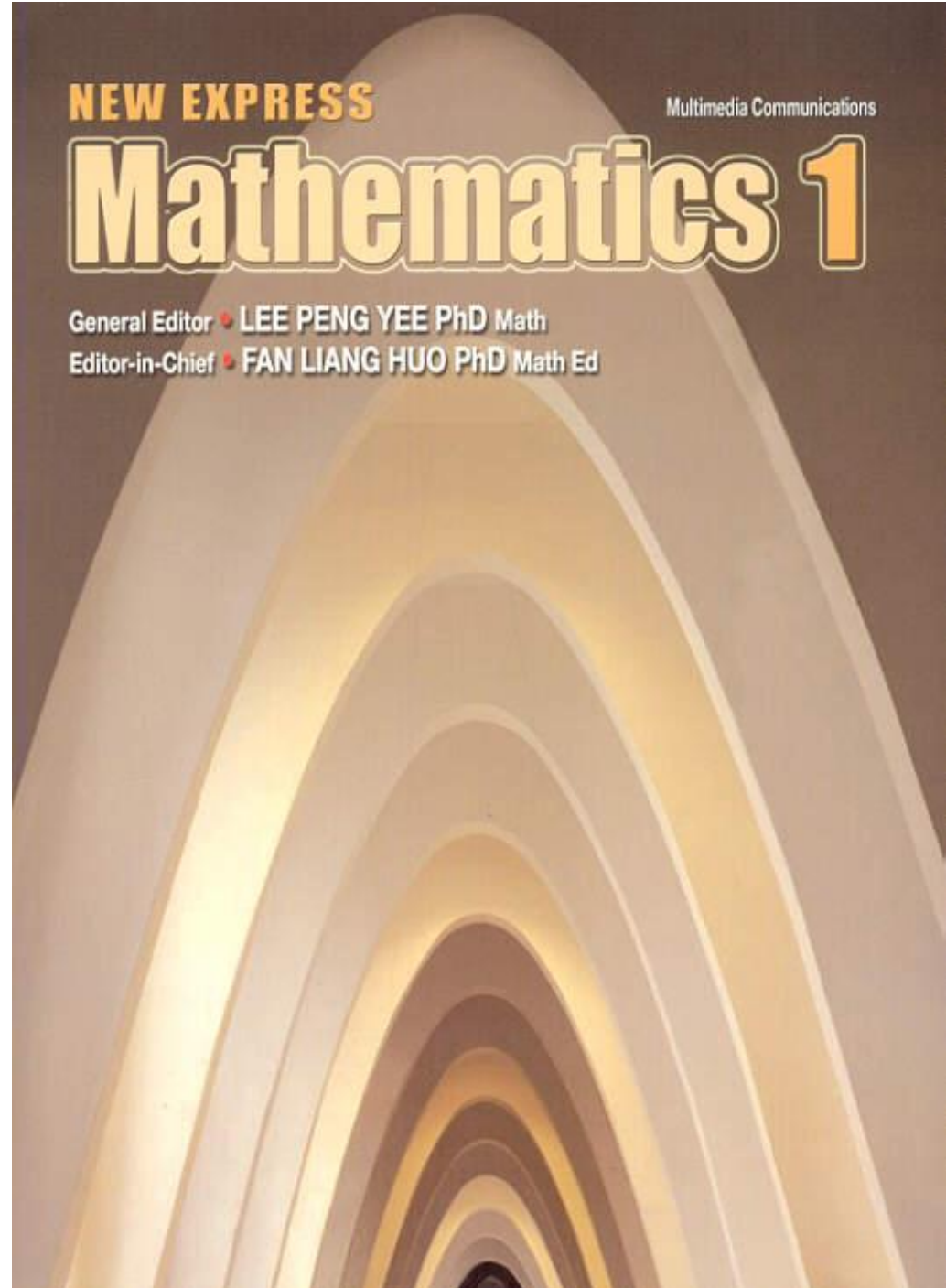
General: ICT

- **Calculator**
- **Computer**
- **Internet**
- **Software (e.g., Excel, GSP, Maple)**

Mathematics Textbooks Selected (Singapore)

1. New: Latest, 2007-current
New Express Mathematics
(by Multimedia Communications)

2. Old: New Syllabus D
Mathematics, 5th edition,
1997-2005
(By Shing Lee Publishers)



Impact of Technology on Mathematics Curriculum

1. What to teach (content of learning)
2. How to teach (a tool to facilitate learning)
3. Why to teach (an objective of learning)

Impact of Technology on Mathematics Curriculum

Difference between what to teach and why to teach:

(a) In what to teach, technology is used as a tool to do mathematics, i.e., tech is a tool.

(b) In why to teach, learn how to use technology to do mathematics is an objective, i.e., tech is part of the objective.

4. Findings (Preliminary)

Findings from Mathematics Textbooks (China)

Current textbooks

There are mainly three types of use of technology:

1. Use of scientific calculators to find value, to calculate, and to explore (Purposes: for what to teach, why to teach, and how to teach)
2. Use of Internet as a resource (often optional only), mainly for reading, project tasks, and exploration work (Purposes: for how to teach/learn)
3. Use of specific software such as excel and GSP (Sec. 3) to construct, calculate (average), and graph (Purposes: for what to teach, but also for how to teach)

(Note: no approximate value for π ; no tables for square roots, cube roots, and tri. ratios; no long division of one polynomial by another polynomial)

Examples from Current Chinese Textbooks (A snapshot)

Category 1

Use of scientific calculators to find value, to calculate, and to explore

1. Ch.2 Lesson 8

Use of Calculators

2. Ch.3 Lesson 4

Using Calculators to Find Square Roots of Numbers

3. In-Class Practice

Use calculators to compare the values of the square of following numbers: 1^2 , 2^2 , 2.5^2 , 5.7^2 , 11^2 , 17^2 , 101^2 . What pattern did you find? If the squares of numbers are changed to the cubes of the numbers, is the pattern you found still true?

[Book 7(1), Ch.2, p.55]

Examples from Current Chinese Textbooks (A snapshot)

Category 2: Use of Internet as a resource

[for project tasks]

(....history of the development of number concepts...).
Please go to library or use internet to search for
information about the history of the development of
numbers and write a short essay introducing the origin
and development of numbers.

[Book 7(1), Ch.1, p.10]

Examples from Current Chinese Textbooks (A snapshot)

Category 3: Use of specific software

.....

Appendix 2

Use computer to construct statistical graphs

(Introducing how to use Excel to draw bar graphs, line graphs, and pie charts)

[Book 7(1), Ch.6, pp.144-145]

Findings from Mathematics Textbooks (China)

Old textbooks (A contrast: overall much less)

1. Use of simple arithmetic calculators to calculate (operations), and find value (limited to square roots, but not cube roots), and not to explore (Purposes: for what to teach, and how to teach)
2. No internet (even there are readings like history of geometry, exploration tasks, etc.)
3. No specific software

(Note: many approximate values for π ; there are tables for square roots, cube roots, and tri. ratios; values such as 30π , $10\sqrt{41}$ were kept in the process as well as in the final answer; there is long division of polynomials)

Findings from Mathematics Textbooks (Singapore)

Current textbooks

Largely similar to Chinese textbooks, there are also mainly three types of use of technology:

1. Use of scientific calculators to find value, to calculate, and to explore (Purposes: for what to teach, why to teach, and how to teach)
2. Use of Internet as a resource (most times optional), mainly for exploration and project tasks (Purposes: for how to teach/learn)
3. Use of specific software such as excel, spreadsheet programme, a graphing software, and a dynamic geometric software (but not specific name given) to construct, graph, and explore, often for In-class Activities (Purposes: for what to teach and how to teach)

(Note: also no approximate value for π , no tables for square roots, cube roots, and tri. ratios)

Examples from Current Singapore Textbooks (A snapshot)

Category 1

Use of scientific calculators to find value, to calculate, and to explore

1. *Ch.1 Lesson 5 Operations on Numbers: Multiplication and division
Use of Calculators [pp. 52-54]*
2. *Ch.11 Lesson 1 Perimeter and Area*

Note for learning

For better accuracy, we can key in the numbers including π or other non-rational numbers, and only approximate the final result displayed.

[Book 1, p.268]

Examples from Current Singapore Textbooks (A snapshot)

Category 2: Use of Internet as a resource

Chapter 3 Rate, Ratio and Percentage

Exploration and project tasks

.....

2. Have you ever wondered why when there is a thunderstorm, you will always see lighting before you hear the thunder? The reason is that light travels faster than sound. Using resources in the library and/or internet, find the speed of light and the speed of sound. How much greater is the speed of light compared to the speed of sound?

[Book 1, p.92]

Examples from Current Singapore Textbooks (A snapshot)

Category 3: Use of specific software

Ch.9 Lesson 9.6 Properties of Quadrilaterals

In-class Activity [Book 1, p.233]

Work in groups. To study the six special quadrilaterals: square, rectangle, parallelogram, rhombus, trapezium and kite. Use paper cut-outs or any dynamic geometry software to carry out the explorations listed in Part I. Draw a table to present your findings.

Part I Exploration

- Sides:*
- 1. Are the opposite sides equal?*
 - 2. Are the adjacent sides equal?*
 - 3. How many sides are equal?*

- Angles:*
- 1. Are the adjacent angles supplementary? (Equivalently, are the opposite sides equal?)*
 - 2. Are the opposite angles equal?*
 - 3. How many angles are equal?*

- Diagonals:*
- 1. Are the diagonals equal in length?*
 - 2. Does one diagonal bisect the other?*
 - 3. Do the diagonals bisect one another?*
 - 4. Are the diagonals perpendicular to one another?*

Findings from Mathematics Textbooks (Singapore)

Old textbooks (A contrast: overall much less use)

1. Use of scientific calculators to find value, to calculate, and to explore (Purposes: for what to teach, why to teach, and how to teach)
2. Use of specific software such as GSP (yes, specific name given) to construct and explore (Purposes: for how to teach)
3. No use of Internet

(Note: long multiplication and division of whole number still there; also many approximate values for π , no tables for square roots, cube roots, and tri. ratios because of use of scientific calculators)

5. Concluding remarks

Four stages about the growth of the impact of technology in mathematics teaching and learning

1st stage

Content of teaching (long division, fractions/decimals, trig. and log. tables etc.)

2nd stage

Method of teaching (Graph Club, GSP, Maple, Excel, etc.)

3rd stage

Representing and resourcing (CD, Internet, online websites)

4th stage

Digitalizing of teaching and learning (technology-embedded textbooks, internet as instructional platform)

Future Directions: A Personal Perspective

Need to think about two kinds of use of technology in textbook development (1. what tech to use, and 2. how to use and for what purpose)

- 1. More interactive**
- 2. More as an objective**
- 3. More integrated and holistic**
- 4. More Internet and communication-based**
- 5. Used more in representation**
- 6. Used more to provide teaching and learning sources (not only as a calculation tool)**

Some final comments

First, technology can make mathematics teaching and learning not only more efficient, but also more effective.

Second, technology must be reflected and, more importantly, embedded into the development of mathematics curriculum including textbooks

Third, to achieve the above target, textbook developers must be familiar with the development of technology. Therefore, textbook developers should include experts in the use of ICT in mathematics teaching and learning, and also collect feedback from teachers and students. (Fan, 2010)

Thank You

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