"Singapore Mathematics"

An investigation into the structure and merits of "Singapore Maths" with a view to judging it's suitability for New Zealand schools.

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Executive Summary

In this report, I describe the structure and underpinning principles of Singapore Maths, the fundamental difference of it, the factors that support its success in Asia, a description of an observed lesson and a recommendation as to its suitability to New Zealand schools.

It should also be read against the report by the New Zealand Initiative Group (June 2014) on Maths teaching in New Zealand.

Purpose and Findings

The purpose of this report was to investigate the composition and suitability of Singapore Maths to New Zealand schools and the finding is that it is most certainly suitable to New Zealand schools and should be adopted as a prescribed Ministry of Education curriculum requirement.

2015 Principal's Sabbatical Report

"Singapore Mathematics"

By Wayne Bainbridge

Singapore Maths is used by the top four consistent math nations in the world, as measured by TIMSS (Trends in International Maths and Science Study) – Singapore, South Korea, Hong Kong and Japan. Since its development in the late eighties, and its revision in 1992, Singapore has surged to the top of the world maths achievement and also severely reduced its underachievement tail. It is used in a number of countries on a school by school basis and in the United States by private schools, charter schools and homeschoolers. In 2014, an Australian version was launched in Australia, titled Prime Maths and made available in New Zealand in 2015.

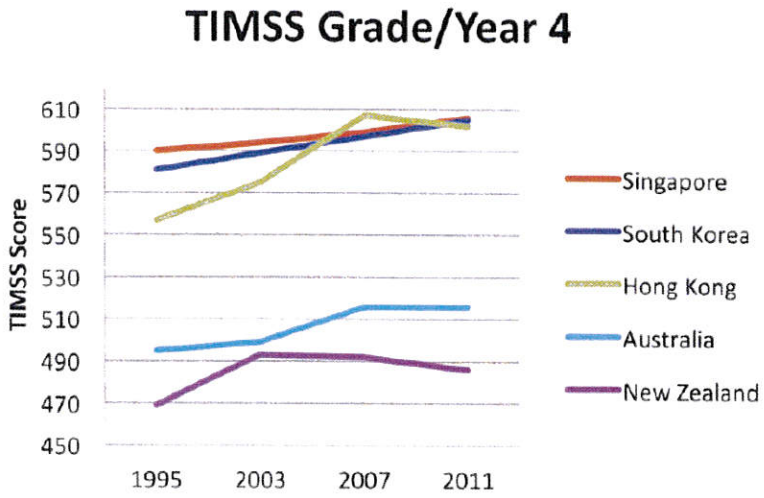
How does it differ?

- Concepts are introduced at an earlier age and covered in depth until mastery.
- Fewer topics are covered in greater depth.
- It is marketed as a complete package with a teacher's book, course book and practice book.
- It is sequentially based on previous knowledge and mastery.
- Teacher's professional learning is embedded within the teacher's book and course book, plus the Bar Model Method "Mathematical Problem Solving".
- Problem solving is central for teaching and learning.
- It is a 'cook book' package which provides a consistent pedagogy which covers topics in depth leading to mastery.

- The teacher's guide includes comprehensive lesson plans with notes to support each page in the student books to show teachers how to effectively teach each lesson.
- The concrete materials for manipulative learning are as simple as paper clips and ice block sticks.
- Each chapter of the books has a review which provides summative assessment.

The New Zealand Scenario

The TIMSS Year 4 results between 1995 – 2011 show that while the results in Singapore, Hong Kong and South Korea all went up, Australia rose then plateaued, the New Zealand score actually declined between 2003 and 2011.



Many New Zealand teachers became disillusioned by frequent changes to the Numeracy Project, rewriting of booklets and changes in testing. Many expressed the view that maths in New Zealand had been 'dumbed down'. Mathematical concepts previously introduced in primary schools were delayed till intermediate or even secondary level, such as fractions, long multiplication, division and the use of algorithms.

Our approach has been described as a scattergun approach with the same topic spread out across different years, rather than being covered in depth to mastery. Scholastic, publishers of Prime Maths, believe Singapore introduces mathematical concepts from one to three years earlier than New Zealand and Australian schools.

DOESN'T ADD UP

Learning about fractions	*Singapore*	*Australia*
Halves and quarters	Year 2	Year 3
Fraction of a whole	Year 2-3	Year 3
Equivalent fractions	Year 3	Year 4
Adding fractions	Year 3	Year 5-6
Subtracting fractions	Year 3	Year 5-6
Mixed numbers	Year 4	Year 4
Improper fractions	Year 4	Year 5
Product of a fraction	Year 4	Year 6-7

Source: Scholastic

New Zealand teachers feel unsupported in their maths learning and fall back on a variety of online resources which they need to search, download and incorporate into their planning which takes considerable time and effort. Because Singapore Maths is a complete package including professional knowledge, planning and summative review it is clearly advantageous. The publishers commissioned Lester Flockton to prepare a comparison between New Zealand curriculum objectives in relations to Prime (Singapore Maths) objectives to show how the latter fits in to the New Zealand Maths Curriculum.

Underpinning Principles

The Primary Mathematics Teaching and Learning Syllabus: Singapore Ministry of Education 2012 clearly outlines the philosophical underpinning of Singapore Maths.

Principle 1

Teaching is for learning; learning is for understanding; understanding is for reasoning and applying and, ultimately **problem solving**.

Principle 2

Teaching should **build on students' knowledge**; take cognisance of students' interests and experiences; and engage them in **active** and **reflective learning**.

The Singapore Ministry of Education firmly believes teachers need support to deliver the curriculum and this is built into the course books used. The two underlying principles are expanded upon.

Teaching Principle 1: Problem Solving

"The learning of mathematics should focus on understanding, not just recall of facts or reproduction of procedures. Understanding is necessary for deep learning and mastery. Only with understanding can students be able to reason mathematically and apply mathematics to solve a range of problems. After all, **problem solving is the focus of the mathematics curriculum**."

Principle 2:

"Mathematics is a **hierarchical subject**. Without understanding of pre-requisite knowledge, foundation will be weak and learning will be shallow. It is important for teachers to check on students' understanding before introducing new **concepts and skills**.

The teaching of problem solving is well illustrated by the following extract from Prime Course book 2 – after 3 years at school. Note the scaffolding.

Mind stretcher

Let's Learn

A train left the first station with some passengers.
At the second station 100 passengers got off and 156 passengers got on the train.
There were 788 passengers left on the train.
How many passengers were there at the beginning?

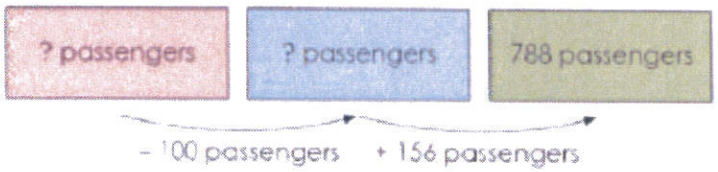
1. **Understand** the problem.

   How many passengers were left on the train?
   How many passengers got off?
   How many passengers got on?
   What do I have to find?
   What should I do?

2. **Plan** what to do.

   I can **work backwards**.

3. Work out the **Answer**.



By working backwards:

788 – 156 = 632

632 + 100 = 732

There were 732 passengers at the beginning.

□ + 156 = 788
□ – 100 = 632

4. **Check**
   Did you answer the question?
   Is your answer correct?

732 – 100 = 632
632 + 156 = 788
My answer is correct.

☑ 1. Understand
☑ 2. Plan
☑ 3. Answer
☑ 4. Check

Some factors which may contribute to the success of Singapore Maths in Singapore

- Children don't start school until they are seven, so may be 'more ready' for formal learning.
- Teaching is a highly respected and well paid profession in Singapore.
- Teachers are entitled to 100 hours of low cost or no cost professional development each year (but not necessarily release based).
- All teachers are trained at the one site, the National Institute of Education.
- Singapore has performance pay.
- Like many Asian countries, teachers and schools in Singapore are both highly respected and highly supported. With no social welfare systems, a parents 'pension' or post retirement living is somewhat dependent on the success of their child or children. Parents support their children's education, after school tutoring is the norm, complaints are rare and any disciplinary issue is well supported by parents.
- There is an expectation that children will do well and parents make sacrifices to ensure their child's success.
- Attendance at parent interviews is usually 100%.
- ICT to support learning is provided.

In such a positively supportive environment, with a well-trained, well respected and well paid teacher workforce, the 'complete package' provided by Singapore Maths is perhaps more likely to be successful than it might be in countries like New Zealand and Australia which don't have the advantages of strong societal support and respect for teachers and schools. Teachers speak with respect and pride of the support they get from their Minister and their Ministry. The present Prime Minister Hsien Loong Lee was formerly the Education Minister (note; Singapore is virtually a one party state with high conformity to societal norms. Dissent is not normal).

What does a Singapore Maths lesson look like?

It looks remarkably like a New Zealand classroom lesson although classroom decorum and teacher interaction are a little more formal. In junior levels, a lot of use is made of concrete materials – plastic beads, paper clips, ice block sticks etc. There is an emphasis on children working together and children learning from each other. No doubt, some teachers may be textbook bound but those I saw 'roved' as in New Zealand classrooms, working with individual groups while the other groups collaborated and problem solved together. Incidentally, class sizes are larger than in New Zealand with classes up to 40 students, the same size as I saw in Shanghai and Beijing.

Much is made about the reliance in Asian countries on textbooks. In the Singapore context, textbooks were used as an adjunct to the learning. The lesson started with a 'Headworx' type exercise of patterning, counting on, counting back and a reminder of yesterday's lesson.

Three groups were operating but the teacher intends to move to four groups:

Group One worked on a follow up from yesterday's lesson using the practice book.

Group Two worked on a game, then another follow up activity (but not book based).

Group Three worked with the teacher using the course book and were directed to tomorrow's follow up activity from the practice book.

When I asked the teacher what was the most useful part of the approach and materials, she was a little perplexed because this was all she had known. However, when prompted she felt the consistent lay out of the books with a review section 'Let's Remember' at the beginning of each

topic chapter; explicit learning intentions for each lesson; 'Let's Do' which is a learning section done with the teacher followed by 'Let's Do' practical application and then solving word problems. The consistency of each lesson based on the structure of the book have familiarity and confidence to the children. They could also use the language of instruction very well. The lesson was similar to a New Zealand style lesson and the textbook was used as part of the follow up range of activities.

Because of the haphazard nature of the New Zealand mathematics curriculum, the lack of coherent resources and in my opinion, poor pre-entry training leading to limited teacher mathematical knowledge, the structured 'package' approach provided by Singapore Maths with emphasis on in-built teacher knowledge, strongly suggest that this resource should be more closely evaluated by the New Zealand Ministry of Education, with a view to its introduction and implementation into New Zealand primary schools.

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