

Textbooks for Singapore Mathematics Teachers' Preparatory Programmes *An Evolving Approach*

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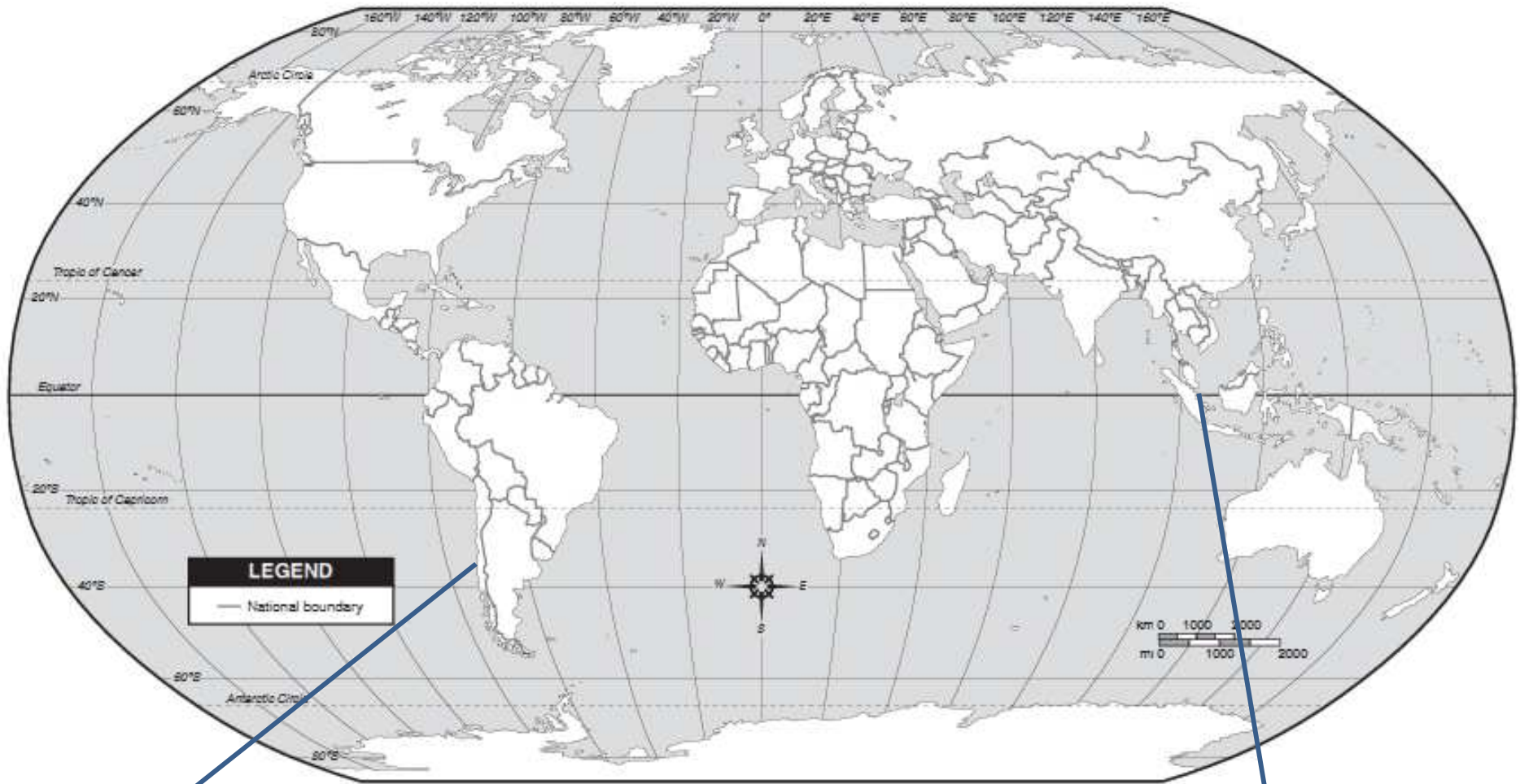
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Outline

- Context
- Overview of courses
- Development of the textbooks for curriculum studies (CS) in mathematics
- Some reactions
- Challenges and issues
- Conclusion

Context

Geographical Location



Chile

Area: 756,102 square kilometre
Population: 16,601,707

Singapore

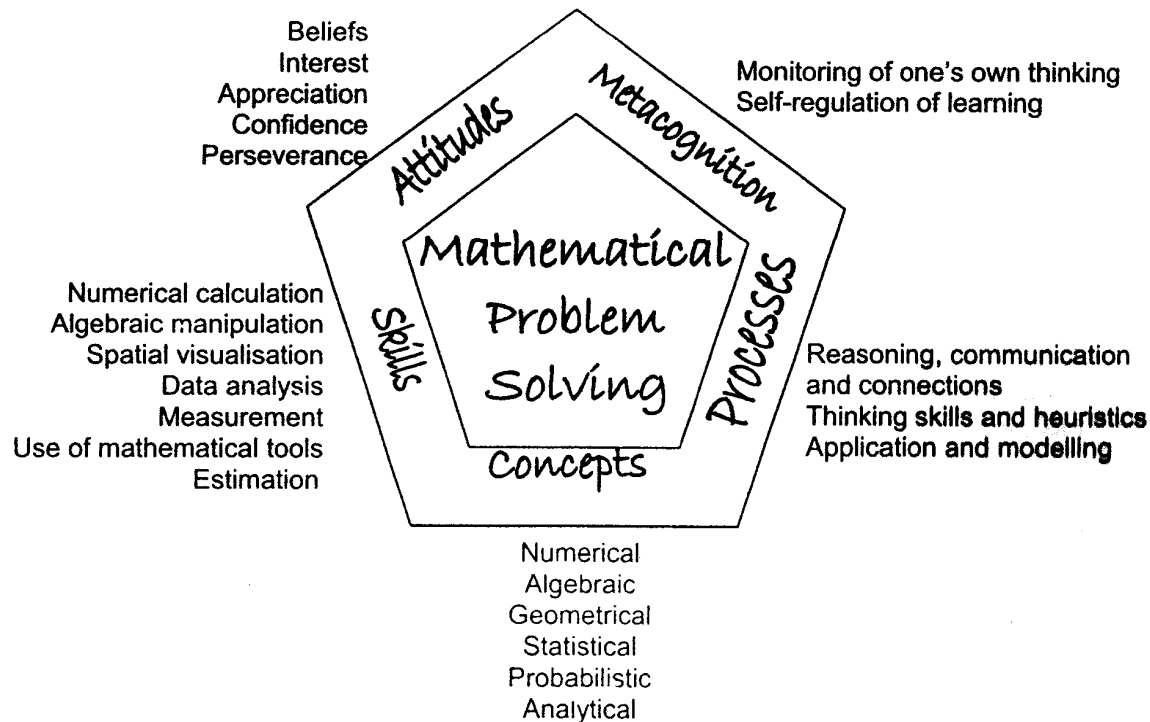
Area: 697 square kilometre
Population: 4,657,542

Source: CIA World Fact Book - <https://www.cia.gov/library/publications/the-world-factbook/index.html>

Mathematics Curriculum

Basically a centrally-controlled national curriculum

The Curriculum Framework



The Key Approaches

- The spiral curriculum
- The concrete-pictorial-abstract development of concepts

Textbooks

- Only those which have been reviewed and approved by the Ministry of Education would be used.

References:

- S.F. Ng. (2009). The Singapore Primary Mathematics Curriculum. In Lee, P.Y., & Lee, N.H. (Eds.), *Teaching Primary School Mathematics: A Resource Book* (pp.15-34). Singapore: McGraw Hill Education (Asia).
- Wong, K. Y., & Lee, N. H. (2009). Singapore education and mathematics curriculum. In Wong, K. Y., Lee, P. Y., Kaur, B., Foong, P. Y., & Ng, S. F. (Eds.), *Mathematics education: The Singapore journey* (pp. 13-47). Singapore: World Scientific.

Teacher Education

NIE (National Institute of Education, an institute of the Nanyang Technological University, is currently the sole provider of pre-service teacher education.

Pre-Service Programmes*

Programme	Entry Requirement	Duration in years	Level of teaching
Postgraduate Diploma in Education (Secondary)	University graduates	1	Secondary
Postgraduate Diploma in Education (Primary)	University graduates	1	Primary
Diploma in Education	A Level or polytechnic graduates	2	Primary
Bachelor of Arts / Bachelor of Science (Education)	A Level or polytechnic graduates	4	Primary or Secondary

**Note: The 3 ½-year Bachelor of Education (part-time) programme is designed for non-graduate primary school teachers, and so is excluded from the above list of pre-service programmes.*

References:

Lim-Teo, S.K. (2009). Mathematics Teacher Education: Re-Service and In-Service Programmes. In Wong, K. Y., Lee, P. Y., Kaur, B., Foong, P. Y., & Ng, S. F. (Eds.), *Mathematics education: The Singapore journey* (pp. 48-84). Singapore: World Scientific.

Overview of Course

Courses Offered

Type of Courses	Purpose of Courses
Academic Subject (AS)	These are university mathematics courses, primarily targeting at pre-service teachers in the Bachelor of Science (Education) programmes and specializing in the study of mathematics.
Subject Knowledge (SK)	These are courses aimed at building up the pre-service teachers' mathematics knowledge for teaching at primary level and the content is closely linked to the Singapore primary school mathematics curriculum but going beyond providing basic knowledge of the topics to inculcating deeper understanding of structures under-girding these topics.
Curriculum Studies (CS)	These are essentially methods courses aimed at equipping the pre-service teachers both mathematical pedagogical content and curricular knowledge (Shulman, 1987)

Shulman, L. (1987). Knowledge and teaching: Foundation of the new reform. *Harvard Educational Review*, 57(1), 1-22.

**Development of the textbooks
for**

curriculum studies (CS) in mathematics

Mathematical Curricular Knowledge & Pedagogical Content Knowledge

	Mathematical Curricular Knowledge	Mathematical Pedagogical Content Knowledge
Shulman (1987)	Involving understanding of how the topics are arranged over time across school experience	Including useful forms of representation of mathematical ideas, powerful analogies, examples, and explanations of mathematics, insights into what makes learning a specific mathematical topic easy or difficult, and the conceptions that students of different ages and backgrounds bring with them to the learning of the topic.

Shulman, L. (1987). Knowledge and teaching: Foundation of the new reform. *Harvard Educational Review*, 57(1), 1-22.

Mathematical Curricular Knowledge & Pedagogical Content Knowledge

	Pre-Active		Interactive
	Mathematical Curricular Knowledge	Knowledge of Planning for Teaching and Learning	Enacting Mathematics for Teaching and learning
Tatto, Schwille, Senk, Ingvarson, Peck, Rowley (2008)	<ul style="list-style-type: none"> Establishing appropriate learning goals Knowing different assessment formats Selecting possible pathways and seeing connections within the curriculum Identifying the key ideas in learning programmes Knowledge of mathematics curriculum 	<ul style="list-style-type: none"> Planning and selecting appropriate activities Choosing assessment formats Predicting typical students' responses, including misconceptions Planning appropriate methods for representing mathematical ideas Linking the didactical methods and the instructional designs Identifying different approaches for solving mathematical problems Planning mathematical lessons 	<ul style="list-style-type: none"> Analyzing or evaluating students' mathematical solutions for arguments Analyzing the content of students' questions Diagnosing typical students' responses, including misconceptions Explaining or representing mathematical concepts or procedures Generating fruitful questions Responding to unexpected mathematical issues Providing appropriate feedback

Totto, M.T., Schwille, J., Senk, S., Ingvarson, L., Peck, R., Rowley, G. (2008). Teacher Education and Development Study in Mathematics (TEDS-M): Policy, Practice, and Readiness to Teach Primary and Secondary Mathematics. Conceptual Framework. East Lansing, MI: Teacher Education and Development International Study Center, College of Education, Michigan State University.

“Teaching involves what has come to be called situated knowledge ... within preparation for the practice of teaching mathematics refers not only to the varied classroom settings in which teachers ultimately practice, but also ...the classroom context...”

Tatto et al (2008).

Totto, M.T., Schwille, J., Senk, S., Ingvarson, L., Peck, R., Rowley, G. (2008). Teacher Education and Development Study in Mathematics (TEDS-M): Policy, Practice, and Readiness to Teach Primary and Secondary Mathematics. Conceptual Framework. East Lansing, MI: Teacher Education and Development International Study Center, College of Education, Michigan State University.

Some Issues In Delivering The CS Mathematics Courses

- Insufficiency of the standard methods course books to address the local curriculum.
- Readiness of new faculty
- Standardization across large cohort.

Development of Textbooks For CS Mathematics Course

The Journey

- Ad hoc notes compiled for circulation.
- Systematic compilation of notes as a resource pack
- Formalization of resource pack for publication as a book

Development of Textbooks For CS Mathematics Course

Some Issues

- Content for book – self-sufficiency vs reinventing the wheel
- Authorship – author-centric vs representation
- Format – standardization vs creativity

Development of Textbooks For CS Mathematics Course

Some Decisions

- General Reading (theories and curriculum issues) and Teaching of Specific Topics
- Reallocation and redistribution of authorships for better representation
- Suggested standard format for chapters on Teaching of Specific Topics, though authors may vary from it as and when deem fit.

Development of Textbooks For CS Mathematics Course *Emphasis*

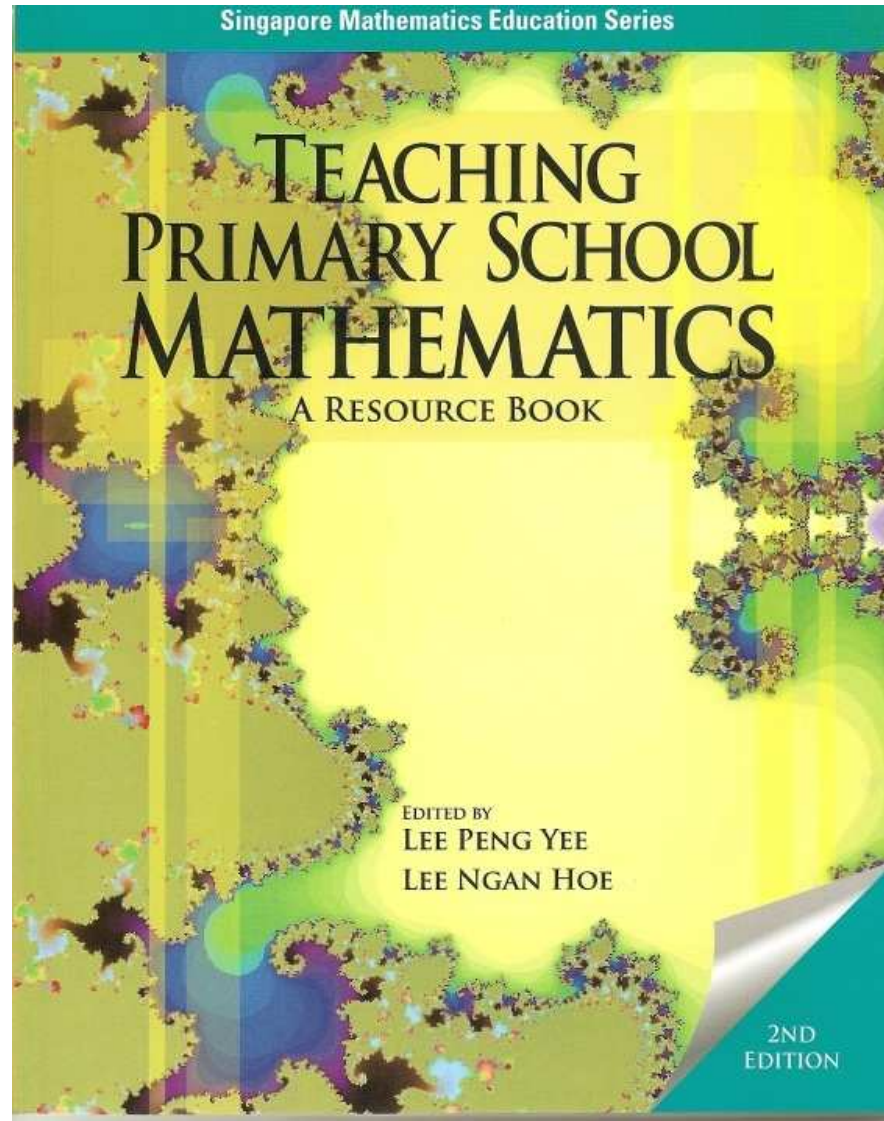
Linkage to the Singapore Mathematics Curriculum

- General reading section to include specifically the key features and approaches of the Singapore Mathematics Curriculum
- Use of illustrations and examples from the local context
 - approaches in teaching of topics taken by common local textbooks; common errors and learning difficulties collected from local classrooms

Development of Textbooks For CS Mathematics Course

A glimpse of the books ...

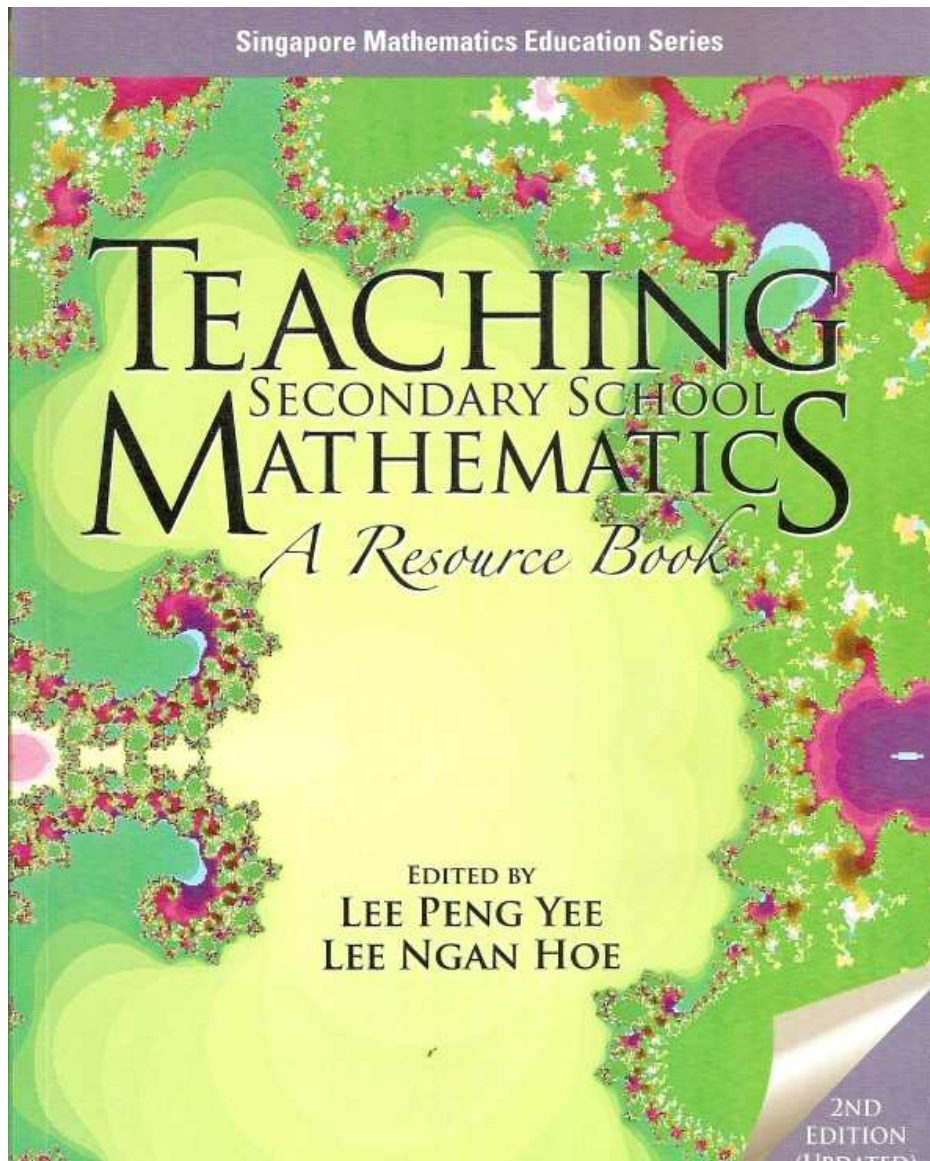
The Primary CS Mathematics Course Textbook



P.Y., Lee., & N.H., Lee. (Eds.),
Teaching Primary School
Mathematics: A Resource Book.
Singapore: McGraw Hill Education
(Asia).

- Coverage – Curriculum Framework and Teaching of Specific Topics
- Syllabus – Spiraling of Curriculum
- Teacher Activity – Case Study for Discussion
- Learning Difficulties & Common Errors
- Reference to Common Approaches Found in Textbook
- Sample of Expected Performance
- Addressing the C-P-A approach
- collected from local classrooms

The Secondary CS Mathematics Course Texbook



P.Y.,Lee, & N.H., Lee. (Eds.),
Teaching Secondary School
Mathematics: A Resource Book.
Singapore: McGraw Hill Education
(Asia).

- Coverage –Teaching of Specific Topics and Reading Resources
- Syllabus – Spiraling of Curriculum (including across levels)
- Addressing Ministry of Education's Initiatives
- Teaching Activity Beyond the School Syllabus
- Strategies that Cut Across Content

Some reactions

A comparative study between United States and Singapore prospective elementary school teachers' performance on proportional reasoning:

The Book Pages (BP) problem was one of the two problems investigated in this study:

David reads 40 pages of a book in 50 minutes. At the same rate, how many pages should he be able to read in 80 minutes?

Ferruci, B.J., Carter, J., & Lee, N.H. (2009). Proportional Reasoning Models in Developing Mathematics Education Curricula for Prospective Elementary School Teachers. In Paditz, L., & Rogerson, A. (Eds.) *The Mathematics Education into the 21st Century Project – Proceedings of the 10th International Conference: "Models in Developing Mathematics Education"* (pp.162-165). Dresden: Dresden University of Applied Science.

- 64 Singapore and 167 US prospective teachers submitted solutions.
- 92% of the Singapore and 72% of the US future teachers submitted correct answers.
- The most commonly submitted approach by Singapore and US participants was to determine the amount read in one minute and to multiply the amount by 80 to get the amount read in 80 minutes. Notably, this approach, often called the unitary method, is a common approach taught to Singapore primary school pupils to handle problems involving proportional reasoning (Collars, Koay, Lee, Ong, & Tan, 2006, p.31, Method 2).
- 52% of the Singapore participants used this approach and 97% of these solutions were correct, while 24% of US participants used this approach and 95% of these US participants solved the problem correctly with the unitary method

Some Reactions From Faculty

- Disagreement in approaches proposed in book.
- There is ownership as each member has a 'stake' in the book

Some Reactions From Mathematics Teacher Educators

- Lack of consistency in format across chapters
 - deserving to be classified as a book?
- The variety of approaches taken to deal with the various topics reflects the need for variety of strategies needed in the mathematics classroom.

Challenges and issues

Raising The Level Of Ownership

- Matching lecturers of mass lectures with authors of chapters.
- Encouraging lecturers to align lectures with approaches proposed in book.
- Constantly collecting feedback to better align the content with the general consensus of the faculty.

Coping With Changes

- Changes in Curriculum.
- Changes in Faculty.
- Changes in Appraisal Emphasis

Conclusion

The books have become a platform for

- Promoting communication and exchange.
- Remaining responsive and relevant.

An evolving document...

both in form & content

A REFLECTON ...

May not have the formula for the guaranteed success of such a book, but one key ingredient is observed to have helped:

Project to be led by someone who is well-respected and accepted as a leading figure in the field among the faculty members.

ENCOURAGING NEWS

- Received expressed interest from both Sweden and China to explore possibility of translating and contextualising the books.
- More consolidated effort in collaborating to write and document.



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Berinderjeet Kaur • Foong Pui Yee
Ng Swee Fong

**MATHEMATICS
EDUCATION**

The Singapore Journey

THANK YOU.

Open Discussion

