

Math in Focus: *The Singapore Approach* **The Underpinning Concept**

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Introduction

Math in Focus: The Singapore Approach is adapted from Singapore's *My Pals Are Here! Maths*. The underpinning philosophy of both series is the same, and their aims and objectives are to ensure children's ability to achieve mastery of mathematics concepts, computational skills, problem solving skills and application of mathematics to daily life activities. ***Math in Focus*** has also adopted both the Eastern and Western approaches to critical and creative thinking, thus preparing students to face challenges ahead of them. The Eastern style of teaching focuses on drill and practice to ensure mastery of facts, computation, and problem solving skills. The approach is related to Piaget's cognitive learning theory that it is not sufficient to just assimilate ideas but also to accommodate ideas learned through drill, practice, and reflection. The Western approach complements the structured style of learning through peer interaction to stimulate thinking that leads to critical, enquiry-based, and creative thinking. In order to achieve these objectives, the author conceptualizes a framework for teaching and learning which were based on some well-proven teaching and learning theories, as well as research on how best children are taught certain mathematical concepts, computational skills, problem solving skills, and application of mathematics into daily life.

Singapore Math Curriculum

My Pals are Here! Maths is written to align closely to the Math framework developed by the Ministry of Education, Singapore. The Singapore Math curriculum has evolved over 20 years. In the 1980's, the focus of the curriculum was on conceptual learning and problem solving. Towards the end of the 1990's, based on the thinking school concept, the Singapore math curriculum expanded to develop different forms of thinking (creative, critical, and enquiry-based) through participation in math activities and solving mathematical problems. The framework of the Singapore math syllabus covers learning skills, concepts, processes, meta cognition, and developing students' attitudes to learn and love mathematics. The Singapore Math curriculum is in line with the NCTM principles and standards.

Pedagogical and Theoretical Background

The ***Math in Focus*** series adopted the constructivist approach to help children master mathematical concepts and skills. The following sequence of activities is used in the textbook: introduction of knowledge, informal assessment and reflection of knowledge, reinforcement of math concepts, and computational

and problem solving skills through peer interaction in group activities and practice. Further activities are incorporated that empower critical and creative thinking in the curriculum, such as the investigative activities and *Put on Your Thinking Cap* problems. To help children construct mathematical knowledge and problem solving skills, presentation of learning concepts needs to be harmonious with children's ability to understand and construct the knowledge. Children need to see connections (emphasized by NCTM in the current standards and principles) between concepts that help them understand and master mathematical concepts, solve mathematical problems, and carry out investigation procedures. **Math In Focus** emphasizes connections so students see the links between concepts and topics, which helps them understand and solve problems such as finding the connection between geometry and numbers.

(i) Adoption of Dr. Jerome Bruner's and Jean Piaget's Theories

The most significant theory, which has been adopted for writing the **Math in Focus** series, is Bruner's theory on representations of mathematical concepts according to different levels of children's thinking. The representation based on the concrete, pictorial, and abstract (CPA) is adopted in the whole series. The way I interpret Bruner's theory is basically parallel to Piaget's stages of development theory. Children at a certain age in general can only conceptualize mathematical concepts depending on their levels of mental development. In this aspect, Bruner's idea was to emphasize concrete representation, which is in harmony with some children's ability to understand mathematical concepts at the early stages. Research shows that children could not depend too much on concrete representation as they need to move on to the next level so that they could conceptualize abstract (complicated) situations using pictorial representation such as the 'model' approach used in Singapore's *My Pals are Here! Maths* and **Math in Focus: The Singapore Approach**. Although not all challenging problems could be tackled using the 'model' method, it plays a significant role to help average and below average students solve the problems based on their levels of thinking at the concrete and semi-concrete operational stage.

(ii) Richard Skemp's Theory of Understanding

The entire **Math In Focus** series also adopts Skemp's theory of instrumental and relational understanding. The gist is when a child understands in relation to other facts (relational understanding), the child can remember better than memorizing the facts without really understanding (instrumental understanding). Relational understanding also helps children to extend their knowledge in problem solving skills. Understanding this approach is related to the CPA approach. Using concrete and pictorial representation helps children to understand the concepts and skills presented.

(iii) Theory on Constructivism

The constructivist's theory is broadly applied in this series. Mathematical ideas are conceptualized by constructing mathematical concepts and skills through simulation and accommodation. They are also enforced through various activities. Activities besides peer interaction involve continuous practice such as using journals for reflection and reinforcement. During peer interactions, the ideas taught are either reconstructed or reinforced to enable correction and understanding of ideas learned. Further constructivism activities are also emphasized to ensure mastery and student confidence in activities such as journal writing, which involves tremendous demand on student's recall and reflection of the ideas they have learned.

Strategies and Methods

Math In Focus is based upon the use of mental computation, model approach, and the heuristics which enhance teaching and learning. Mental computation is imminent if the children are to master mathematical skills and problem solving. Thorough speed and the ability to operate mentally helps children to excel in math. The program introduces not only the mental strategies, but also prepares students to perform mental sums through the use of number bonds and manipulatives like unit cubes and the math balance.

The use of model approach or bar modeling is based on the fact that children at the elementary stage would not be able to solve abstract problems. The introduction of the model approach helps children to visualize and be able to see connections between facts and information which embeds in the questions. The ability to see connections helps pupils to solve difficult and complicated problems. This is the cutting edge of the model method. In other words, the model method simplifies the problem solving situation and translates to a form which average and below average students can conceptualize.

The use of heuristics is also another strategy which helps average and below average students to tackle challenging questions. Based on Richard Gardner's theory, each child has his/her own talent to learn, and only by identifying the talent can you innovate the method to help them. This philosophy is adopted in this series. The use of diagrams, some manipulatives, games, and active participation are in accordance to Gardner's theory.

Creativity, Critical, and Enquiry Thinking

Educationists have advocated creativity, critical, and enquiry thinking. Achieving these thinking skills is the key objective of the **Math in Focus** series. Creativity could be trained if the children are put into an environment where their mental thinking is evoked. The series contains many activities where they are asked to create alternative solutions to a problem. Likewise, critical thinking is evoked through activities that require children to give suggestions on situations where variations are incorporated.

Conclusion

The ultimate objective of the **Math In Focus** series is to develop a program that enables children to empower their thinking and develop skills that will help lead them to a better future in society. This can be achieved through getting children involved in various activities (peer activities and interaction, further practice and journal writings), which helps them to develop creativity, critical thinking, and enquiring minds.

Math In Focus has adopted some useful research, teaching, and learning theories to develop the program, and led the author to write training materials which help students with mathematical concepts, skills, problem solving and mathematical investigations. The materials from **Math in Focus** were adapted from *My Pals are Here! Maths*, which was the most popular series used by Singapore schools. The *My Pals are Here! Maths* series has shown proven results in the 2007 TIMSS results. Children using this series were proven to excel in the international survey.

About the Author

Dr. Fong Ho Kheong is an Associate Professor and Head of the Math and Science Department of the Bahrain Teachers College of the University of Bahrain in the Kingdom of Bahrain. He is also a former Associate Professor of the National Institute of Education, Nanyang Technological University, Singapore. He was involved in training Mathematics teachers in the National Institute of Education, Singapore, for 25 years. He also worked in the Education Testing Centre, University of New South Wales, Australia, dealing with assessment in primary Mathematics. He is the Founding President of the Association of the Mathematics Educators, Singapore. Dr. Fong obtained his Ph.D. from the University of London. He specializes in teaching high ability children and children who have problems in Mathematics. His research work includes diagnosing children with mathematical difficulties, teaching them to think to solve mathematical problems, and apply psychological theories for the teaching and learning of Mathematics. His experience in curriculum development has led him to innovate the use of the model drawing approach to tackle challenging problems. He has published more than 100 journal articles and research reports, as well as primary and secondary Mathematics books.



He is the consultant and principal author of Marshall Cavendish's *My Pals are Here! Maths* series, which is currently being used by 80% of the primary schools in Singapore. He is the principal author of ***Math in Focus: The Singapore Approach***, the United States Edition of *My Pals are Here!*, also published by Marshall Cavendish and distributed in the U.S. by Great Source, an imprint of Houghton Mifflin Harcourt.

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