

Math in Focus: *Singapore Math by Marshall Cavendish* **The Underpinning Concept**

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Introduction

Math in Focus®: Singapore Math by Marshall Cavendish 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 activities in daily life. **Math in Focus** has also adopted both 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 which states that it is not sufficient to just assimilate ideas but also to accommodate ideas learned through drill, practice, and reflection. The Western approach complements this structured style of learning through peer interaction to stimulate critical, enquiry-based, and creative thinking. In order to achieve these objectives, the authors conceptualized a framework for teaching and learning which was based on well-proven teaching and learning theories, as well as research on the best ways to teach children certain mathematical concepts, computational skills, problem solving skills, and the application of mathematics in daily life.

Singapore Math Curriculum

My Pals are Here! Maths is written to align closely with the math framework developed by the Ministry of Education, Singapore. The Singapore math curriculum has evolved over 20 years. In the 1980s, the focus of the curriculum was on conceptual learning and problem solving. In the late 1990s, 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, metacognition, 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 has 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 to use 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 develop problem-solving skills, presentation of learning concepts needs to match children's ability to understand and construct the knowledge. Children need to see how mathematical concepts are interrelated (emphasized by NCTM in the current standards and principles) in order to understand and master such mathematical concepts, solve mathematical problems, and carry out investigation procedures. **Math in Focus** emphasizes these interrelationships 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 the 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. Bruner's theory parallels Piaget's stages of development theory. Children at a certain age, in general, can only conceptualize mathematical concepts depending on their level of mental development. In this aspect, Bruner's idea was to emphasize concrete representation, which is in accord with some children's ability to understand mathematical concepts at the early stages. Research shows that children cannot depend too much on concrete representation, as they need to move on to the next level so that they can conceptualize abstract (complicated) situations using pictorial representation, such as in the 'model' approach used in Singapore's *My Pals are Here! Maths* and **Math in Focus**. Although not all challenging problems can be tackled using the 'model' method, it plays a significant role in helping average and below-average students solve the problems based on their level 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 theory here is that 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, such as using journals for reflection and reinforcement, in order to provide continuous practice. During peer interactions, the ideas taught are either reconstructed or reinforced to enable correction and understanding of ideas learned. Further constructivist activities are also emphasized to ensure mastery and student confidence in activities such as journal writing, which places great emphasis 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, the model approach, and the heuristics which enhance teaching and learning. Mental computation is paramount if children are to master mathematical skills and problem solving. With speed and the ability to operate mentally, children are able 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 the model approach or *bar modeling* is based on the fact that children at the elementary stage are unable to solve abstract problems. The introduction of the model approach helps children to visualize and see connections between facts and information embedded in the questions. This ability to see the connections helps pupils to solve difficult and complicated problems. This is the strength of the model method. In other words, the model method simplifies the problem solving situation and translates it 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 tackle challenging questions. Based on Richard Gardner's theory, each child has to develop his/her own talent, and only by identifying the talent can a method be implemented to help them. This philosophy is adopted in this series. The use of diagrams, manipulatives, games, and active participation are in accordance with Gardner's theory.

Creative, Critical, and Enquiry Thinking

Educationists have advocated creative, critical, and enquiry thinking. Achieving these thinking skills is the key objective of the **Math in Focus** series. Creativity can be trained if the children are put in an environment where their mental thinking is stimulated. The series contains many activities where they are asked to create alternative solutions to a problem. Likewise, critical thinking is stimulated through activities that require children to use their enquiry skills and abilities on multiple-choice exercises.

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 help 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 has 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** are adapted from *My Pals are Here! Maths*, which is the most popular series used by Singapore schools. Children using the *My Pals are Here! Maths* series have excelled in math and this can be seen in the results of the 2007 TIMSS.

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 at 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 how to think when solving mathematical problems, and applying 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 the majority of primary schools in Singapore. He is the principal author of ***Math in Focus: Singapore Math by Marshall Cavendish***, the United States Edition of *My Pals are Here!*, also published by Marshall Cavendish and distributed in the U.S. by **Houghton Mifflin Harcourt Specialized Curriculum**.

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