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Introduction

Mathematics is the key to opportunity. . . . For students it opens the doors to careers. For citizens, it enables informed decisions. For nations, it provides knowledge to compete in a technological economy.
(National Research Council 1989, 1)

STANDARDS-BASED MATHEMATICS: THE FOUNDATION OF AN EXCELLENT CURRICULUM

To design programs that are responsive to the intellectual strengths and personal interests of students, we must fully explore the alternatives to traditional mathematics instruction. We need to examine not only what is taught but also how it is taught. To do this we need to explore cognitive theories and how children learn.

THE ROLE OF MULTIPLE INTELLIGENCES IN TODAY'S MATHEMATICS CLASSROOM

To make mathematics available to all students and to be responsive to the intellectual strengths of students, we need to examine the advances that have been made in the field of cognitive psychology. Howard Gardner theorised the existence of multiple intelligences to explain our intellectual potential. In his seminal book, *Frames of Mind* (1983), he encourages people to expand their definitions of intelligence, scrutinise their attitudes toward learning, and expand their beliefs about the way children learn. Relying on a framework of cognitive and developmental psychology, Gardner presents a case for the existence of multiple intelligences.

A careful examination of Gardner's theory of multiple intelligences by mathematics educators would most certainly influence the pedagogy and/or mathematical *process*. By utilising Gardner's theories and incorporating them into the mathematics classroom, educators can support the strengths and shore up the weaknesses of their students.

How do multiple intelligences play out in the mathematics classroom? Following is a brief explanation of each of the intelligences identified by Gardner (1983, 1995).

Verbal/Linguistic Intelligence

This is the intelligence of language and words. Students who are strongly linguistic love to read, write, and discuss ideas. Educators can encourage students to develop their verbal/linguistic intelligence by requiring both symbolic and verbal solutions to problems. All of the activities in *Multiple Intelligences and Standard-Based Mathematics* provide a journal question to encourage this intelligence.

Logical/Mathematical Intelligence

This is the intelligence of numbers and logic. Students whose strength is this intelligence love to problem solve and use symbolic abstractions. Activities that relate to real-world mathematics encourage students to develop this intelligence by demonstrating the power and usefulness of mathematics.

Visual/Spatial Intelligence

People whose strength is visual/spatial understand their physical world. Research has indicated that there appears to be a correlation between the mathematical performance of females and their spatial intelligence: the higher a girl's spatial skill, the higher her mathematical achievement (Tartre 1990). To help students see things in images and pictures, teachers can encourage the use of visual mathematical representations. These are provided in many of the activities contained in this book.

Musical/Rhythmic Intelligence

This is the intelligence of rhythms and melodies. While each of us holds musical capabilities to some degree, in some societies, students are encouraged to develop their musical intelligence to a heightened degree. For example, in Japan, musical/rhythmic intelligence is considered a vital part of the educational process, and thus most students study Suzuki, a method of learning to play the violin. While Australian educators do not pursue the development of this intelligence to the same degree, we can encourage our students by taking advantage of the connection between rhythms and fractions and putting important mathematical concepts and rules to music. The Collection of Maths Medleys address this intelligence in a unique way.

Bodily/Kinaesthetic Intelligence

People with a strong bodily/kinaesthetic intelligence are hands-on learners who enjoy tactile experiences. By using manipulatives and encouraging the concrete, physical representation of mathematics concepts, teachers can improve bodily/kinaesthetic intelligence and bring comfort to those students who excel in this area.

Interpersonal Intelligence

Those who possess an enhanced interpersonal intelligence love working with other people. The activities and projects presented in this book are designed to foster collaboration and they encourage students to work together to solve a mathematical problem. These lessons cultivate the growth of interpersonal intelligence as they develop deeper maths concepts.

Intrapersonal Intelligence

This is the intelligence of the inner self. Understanding and being in touch with one's feelings and thoughts are at the centre of this intelligence. By encouraging students to explain their reasoning and thinking, they become more self-reflective and develop their intrapersonal intelligence.

Naturalist Intelligence

In the mid-1980s, Gardner suggested an eighth intelligence—the naturalist. He describes individuals who possess this intelligence as people who can classify, order, and define objects based upon common attributes. Children who can “make acute discriminations among cars, sneakers, or hairstyles” (Gardner 1995, 206) exemplify naturalists in our modern society. This intelligence can be encouraged in the mathematics classroom by using manipulatives that challenge students to find common attributes, Venn diagrams, and logic activities to classify objects by their characteristics.

THE ROLE OF ASSESSMENT IN THE NEW MILLENNIUM MATHEMATICS CLASSROOM

Students who are participating in worthwhile mathematical tasks are active and are discussing, questioning, modeling, reasoning, and problem solving. Traditional evaluation strategies would reveal to a limited degree the learning that is taking place. Educators are experimenting with alternatives to traditional assessment as a complement to typical testing. What is the difference between assessment and testing?