1 What If?

This book is a compilation of the lessons I've learned in my quest to become a better teacher and learner of mathematics. My purpose is to share my research, my experiences, and the experiences of my colleagues and peers to demonstrate how literacy and numeracy are similar, and thereby to influence classroom instruction for mathematics. One of my assumptions is that while a vast number of elementary teachers feel proficient and competent in teaching reading, not many of them have the same level of comfort or confidence in teaching mathematics. The reasons for this are varied, but the implications for teaching and learning are significant. How can we build on teachers' literacy strengths to help them teach and learn math? This book will take a look at current literacy instructional strategies and give examples of how they could be used in the teaching of mathematics.

Roland Barth (2003) defines the purpose of reflection as "nothing less than an internal dialogue with oneself. It is the process of bringing past experiences to a conscious level, analyzing them, and determining better ways to think and behave in the future" (p. xxi). It is in looking back while looking ahead that educators can continue to refine, revise, and in some cases overhaul their practices.

This book is meant to be a tool for reflection, helping you gain a new perspective based on the premise that mathematics and reading are more alike than different. I have paused in specific places to pose questions that encourage those reflective moments and give you an opportunity to relate to the text through your own experiences—to have your internal dialogue. Please use the spaces provided to document your thinking.

MAKING SENSE

Let's begin with the big picture to gain some perspective on our current reality. Does this scenario sound familiar?

You are at a dinner party, and during a conversation about the rising price of gasoline, someone asks how many miles per gallon people's vehicles get. As the comments move around the room, one person responds, "I have no idea about the miles per gallon my car gets and the current gas prices. I was never good at math!" Everyone smiles politely, some shake their heads in agreement, and others say aloud, "I was never good at math either."

Somehow there is consolation in acknowledging the lack of mathematical ability among adults. But imagine this scenario as the conversation continues:

As the conversation builds, someone refers to a recent article in Time *concerning alternative energies and their potential for lessening our dependence on foreign oil. As opinions are shared, one person responds, "I have no idea about the article or possible alternate sources of energy. I was never good at reading!"*

Suddenly the room becomes very quiet; there is no agreement.

Why is it that as a society we're willing to freely admit that we're not competent mathematicians but would disguise any struggle we had with being literate? What if we decided that numeracy and literacy are both languages we should be fluent in?

Can you think of how numeracy and literacy might be alike?

Marilyn Burns describes math as an American phobia "right up there with snakes, public speaking, and heights" (1998, p. ix). Commonly expressed sentiments about mathematics perpetuate the myth that real mathematical understanding is available to a limited number of people. Burns gives examples of these expressions:

> "Only some people are good in math."
>
> "You're only good in math if you have the math gene."
>
> "People who are good in math wear thick eyeglasses and plastic pocket protectors." (p. ix)

These negative beliefs and assumptions have permeated our culture and, in effect, have limited people in their daily lives and had long-term consequences on their livelihood. Because innumeracy in today's world deprives students of opportunity as well as competence in everyday tasks, it is vital that students understand the mathematics they're learning.

In the United States, there are currently 80 million workers whose everyday responsibilities require the use of basic Grade 6 arithmetic. Because many workers' computation skills are limited, some businesses have added pictures of meal orders to cash registers or provided registers that indicate correct change to cut down on calculation errors. By doing so, however, we deprive people of the necessity to actively think about the numbers involved in the transaction and thus further limit their real-world application of mathematics. Have you ever presented a clerk with money after he or she has entered an amount into the register and observed how stunned that person was by the need to personally calculate the change? To reverse this current direction, it is imperative that we begin to expect more from ourselves as educators and from our students as mathematicians.

Mathematical literacy involves more than proper execution of procedures; it requires a knowledge base and the competence and confidence to apply this knowledge in the practical world. A mathematically literate person can solve day-to-day problems, make estimations, interpret data, reason numerically, and communicate using mathematics. As our knowledge expands and the economy evolves, more people are working with technologies or in settings where mathematics is foundational. Processing of information, problem solving, and using numbers and symbols to communicate are becoming routine job requirements.

Conversations between the business community and educators reveal that expectations for student numeracy are similar to those shared for student literacy. Business leaders are looking for employees with pertinent mathematical skills:

- A strong number sense, including the ability to estimate and judge the reasonableness of an answer and to demonstrate fluency and flexibility when engaging in situations dependent on mathematical understanding
- Confidence in using different methods to measure time, money, length, etc.; experience using appropriate tools to do so; and a level of accuracy in the measurement and computation
- Familiarity with functions, change, variation; a strong spatial sense, including the ability to find routes on maps and to visualize problems
- Statistical and logical reasoning skills—the ability to support or justify arguments and the ability to explore and compare alternate strategies for solving problems

The workplace is one arena requiring mathematical understanding and proficiency, but the larger arena is outside the workplace. Mathematics is a part of everyday life, and therefore we all need to have a certain level of confidence and competence in our use of it to successfully navigate our world. Whether we're in the grocery store deciding which product is a better deal, at dinner adding up our portion of the tab or figuring the tip, in the convenience store trying to determine whether the clerk gave us the correct change, or contemplating which apartment we can afford if we make $100 per week, we all rely on everyday mathematics when we make daily decisions. Mathematical literacy is one of the keys to coping with a changing society, and we as educators need to consider how we're preparing students for the real world.

In its report *Helping Children Learn Mathematics* (2002), the National Research Council (NRC) shares its findings on the teaching and learning of elementary school mathematics. The report argues for an instructional goal of "mathematical proficiency," a broader outcome than that of mere procedural knowledge. The report further suggests that a balance of five intertwined strands comprising the idea of mathematical proficiency should guide the teaching of mathematics. Emphasizing one strand and expecting that the others will develop as a result of this singular focus has been ineffective in supporting mathematical proficiency. Weaving the strands together by connecting ideas and developing overall understanding forms a solid structure from which to build more sophisticated ideas and increase mathematical proficiency.

The NRC defines these five strands as follows:

1. Conceptual understanding—comprehension of mathematical concepts, operations, and relationships

2. Procedural fluency—skill in carrying out procedures flexibly, accurately, efficiently, and consistently

3. Strategic competence—ability to formulate, represent, and solve mathematical problems in a variety of contexts

4. Adaptive reasoning—capacity for logical thought, reflection, and explanation and justification of one's thinking
5. Productive engagement—ability and inclination to see mathematics as sensible, doable, and worthwhile

In considering these five strands as necessary to the building of an effective mathematics experience for students, we must begin to look more closely at teacher instruction. "Despite the common myth that teaching is little more than common sense or that some people are just born teachers, effective teaching practice can be learned" (NRC, 2001, p. 369).

What are some ways that you use mathematics in your everyday life? How do they relate to the content you teach?

A CHANGING LANDSCAPE

Society has always valued literacy. If we are to navigate the endless maze of communication that faces us daily, it is imperative that we understand written and spoken words. Literacy is an important factor in determining student success, and we have spent much time and money at the local and federal levels in an effort to raise a nation of literate citizens. Isn't it enough, then, if students can read? Do they really need to be numerate?

Have you had access to quality professional development in mathematics during the past 5 years?

According to Robert Ashlock, we are a society "drenched with data" (2002, p. 3). Technology is changing our world, and quantitative literacy, or numeracy, is now essential for making sense of the landscape. Students' experiences and instruction need to reflect these changes. Our instruction must enable students to become mathematically proficient so that they are prepared for the real world.

In 1989, the National Council of Teachers of Mathematics (NCTM) stated, "Today's society expects schools to insure that all students have an opportunity to become mathematically literate, are capable of extending their learning, have an equal opportunity to learn, and become informed citizens capable of understanding issues in a technological society" (p. 3).

Educators and researchers recognize that while articulating what should be learned is essential, so is articulating how it should be taught, and the NCTM continued its work in an effort to better articulate goals for both the teaching and the learning of

In this changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures. A lack of mathematical competence keeps those doors closed.

—NCTM, *Principles and Standards for School Mathematics,* p. 5

mathematics. The *Principles and Standards for School Mathematics* (NCTM, 2000) and the *Research Companion* (NCTM, 2003) further elucidated the important concepts and processes all mathematically proficient students need to acquire by Grade 12.

We need to develop experiences for students that will enable them to value mathematics and feel confident and competent in their abilities to reason, solve problems, and communicate their thinking. These aspirations for students are certainly parallel to what we want them to learn from their reading experiences.

In the past two decades, a number of systems, programs, tools, and mandates have been implemented to encourage our students to become confident and capable readers—to value reading, to solve problems by using strategies to understand text, and to communicate by understanding, inferring from, and reflecting on the written word. We now need to begin developing systems, programs, tools, and resources at local, state, and federal levels to support numeracy with the same vigor. I suggest that if we can recognize the similarities in the disciplines, we are closer to creating a nation of mathematically literate citizens. If we build on what we as elementary teachers know to be sound instructional practices for literacy, we can become more effective in providing sound instructional practices for numeracy.

The remainder of this book will explore the connections between the disciplines to help further uncover the developmental growth involved in becoming numerate and the instructional implications of this. Chapter 2 will focus on how students become proficient in literacy and numeracy by giving an analysis of the processes and structures of both content areas. Chapter 3 moves into the realm of understanding and comprehension, and Chapter 4 looks specifically at developmental stages of mathematical understanding and procedural and conceptual knowledge. Finally, Chapter 5 provides examples of how teachers are making use of these connections in their classrooms and gives you some ideas to try in your own classroom.