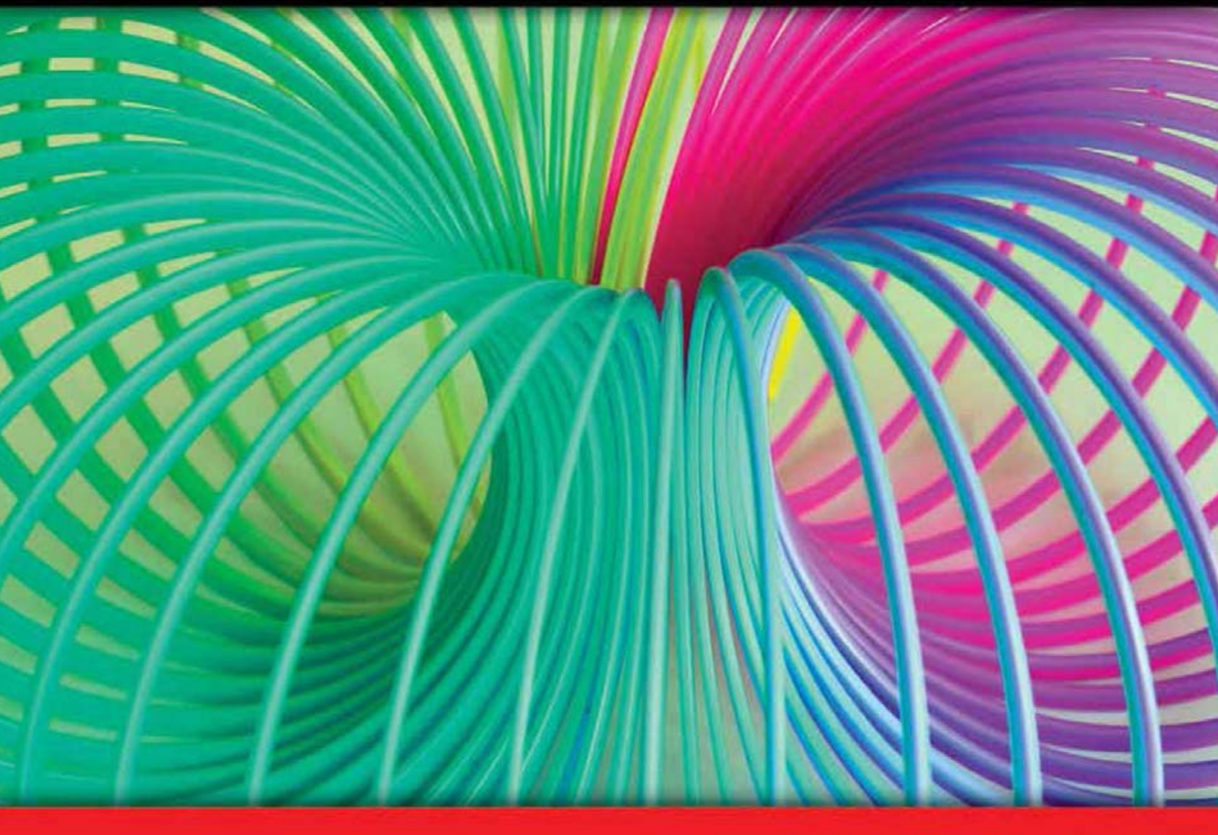
Shell Education

Guided MATH

Levels K–2

Daily Math Stretches

Building Conceptual Understanding



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Introduction

Promoting Mathematical Literacy for the 21st Century with Math Stretches

Teachers in schools everywhere face increasing challenges as state mathematics standards are becoming more rigorous. In an attempt to guarantee increased rigor and consistency in mathematics instruction, the possibility of national mathematics standards is on the horizon. National standards are currently being drafted and may well be adopted throughout the United States within a few years. Additionally, dedicated teachers must pursue the goal of fully preparing each of their students for the mathematical demands of living and working in the 21st century. To do so, they must ensure that their students become mathematically literate.

Mathematical Literacy

What exactly is mathematical literacy? The Mathematical Sciences Education Board, in its study *Everybody Counts,* emphasizes that math is a science of pattern and order that helps people understand the world around them (1989, 31). The role of mathematics in helping people understand the world around them relates directly to the concept of mathematical literacy.

Expanding on that concept, the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA) defined mathematical literacy as "an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen (2006, 72)." Leslie Minton's definition in *What If Your ABCs Were Your 123s* (2007, 4) echoes and supplements that definition by stating that mathematical literacy is "more than proper execution of procedures, it requires a knowledge base and the competence and confidence to apply this knowledge in the practical world."

Based on these definitions, it is apparent that students in today's world must acquire more than just computational skills and procedural fluency to be considered mathematically literate. In addition to competency in those areas, deep conceptual understanding is essential as well as the ability to communicate mathematically and apply this knowledge of mathematics to the real-world problems encountered in daily life.

Current Mathematics Instructional Methods

In spite of increasing demands in the workplace for mathematically literate workers, the vast majority of students never move beyond a formal knowledge of mathematics, mastering basic skills and procedures without ever gaining a true understanding of the discipline (MSED 1989, 58). A recent study of elementary classrooms (Pianta et al. 2007, 1,795–1,796) found that fifth-graders spent 90 percent of their time in their seats listening to the teacher or working alone and received five times as much instruction in basic skills as instruction focused on problem solving or reasoning. For students in first and third grades, the ratio was 10:1. Furthermore, the students in this extensive, multi-year study had few opportunities to learn in small groups, to improve analytical skills, or even to interact extensively with their teachers.

Current Mathematics Instructional Methods *(cont.)*

According to the findings of this study, the traditional whole-class instruction model continues to be the dominant mode of instruction in today's schools. As a result, mathematical literacy is a serious problem in the United States according to the Mathematics Advisory Panel (U.S. Department of Education 2008). Why, if most teachers are caring educators who are dedicated to teaching all of their students to become mathematically literate, does mathematics instruction flounder?

Although mathematics methods courses offer pre-service teachers effective methods of instruction, most teachers begin their careers in schools where traditional methods continue to dominate instructional time. Prior to the increased rigor of state mathematics curriculums and the advent of high-stakes tests, these methods seemed to be sufficient. Although teachers may attempt to work with small groups, provide opportunities for students to complete performance tasks requiring problem solving, and encourage mathematical communication in their classrooms, they may not receive support from their peers and may even be ostracized for these efforts. Therefore, lacking collegial support, it is not surprising that they revert to the kind of instruction they most likely received when they were in elementary school, the kind with which they are most familiar and most comfortable—the traditional whole-class, exclusively teacher-directed model.

Times may be changing. As new, more demanding performance standards for mathematics are implemented, teachers are searching for ways in which they can increase their students' mathematical achievement. During the last decade, many teachers modified their instructional practices for literacy with great success. Oddly enough, many of the same teachers who have embraced more effective literacy instructional strategies have been slow in adopting the same methods for teaching mathematics. Now, however, having gained experience working with small, flexible groups of students to meet individual needs, and having observed the gains in literacy achievement of their students, they are exploring ways to more effectively promote the mathematical literacy of their students.

Research-Based Best Practices for Teaching Mathematics

Making Connections

Some years ago, literacy teachers began reflecting about what they actually did themselves as readers to make meaning from the texts they read. As a result of their reflections, they identified seven metacognitive strategies that good readers use to improve their reading comprehension. By providing explicit, long-term instruction on how to use these strategies, teachers are able to help their students improve their reading comprehension (Keene and Zimmerman 1997, Harvey and Goudvis 2000, Owocki 2003).

Research-Based Best Practices for Teaching Mathematics *(cont.)*

Making Connections *(cont.)*

One of these seven reading comprehension strategies involved making connections—to oneself, to the text, and to the world. As students make connections when reading, they call upon existing *schema* (prior knowledge) to construct understanding from the text. The process of drawing upon prior knowledge to make sense of new experiences or information is not limited to reading. According to Van de Walle, Karp, and Bay-Williams (2010, 20) "your brain is applying prior knowledge to make sense of new information," no matter what the activity.

In mathematics, making connections helps students as they build conceptual understanding. The more they are able to connect related ideas, the greater the depth of their understanding of mathematics (Hyde 2006, 40). While some students quickly recognize connections when introduced to new concepts, other students need encouragement and explicit instruction on making math-to-self (personal experiences), math-to-math (concept to concept), math-to-other content areas, and math-to-world connections. By examining mathematical concepts in a variety of contexts and sharing experiences with their classroom peers through class discussions facilitated by skillful teachers, students' prior knowledge is activated, leading both to conceptual understanding and increased interest, curiosity, and sense of purpose (Brummer and Macceca 2008, 64).

According to the National Council of Teachers of Mathematics (2000, 64), "When students can connect mathematical ideas, their understanding is deeper and more lasting. They can see mathematical connections in the rich interplay among mathematical topics, in contexts that relate mathematics to other subjects, and in their own interests and experience." The deeper understanding that students gain through recognizing connections "equates to greater utility and versatility of the knowledge of the learner" (Bamberger and Oberdorf 2007, 2).

Therefore, if the goal of educators is to help students achieve mathematical literacy, then each mathematical idea that they teach should be so well understood by students that it is embedded in a "rich web of related mathematical ideas" (Van de Walle and Lovin 2006, 3). If students lack an understanding of this "web," they will see each concept they "learn" as an isolated skill. They will not be able to apply these skills to solve problems that have not already been explicitly taught, nor will they be able to extend their knowledge to new learning (Carpenter, Ansell, and Levi 2001). According to Fosnot and Dolk (2001, 4), understanding mathematical relationships, including the process of setting them up and communicating them to others, is at the heart of mathematics. Thus, it is the responsibility of teachers to provide their students with the learning experiences that allow them to construct mathematical meaning and discover the myriad connections within mathematics.