

# Introduction

**T**his book was completely rewritten in 2012 and 2013, in order to address the ongoing transitions in mathematics education. From the author's perspective, the transitions in education today make this one of the most challenging tasks I've ever undertaken. Almost all of the states are moving toward implementation of response to intervention in mathematics and increased use of technology for instruction, and most are moving toward implementation of the Common Core State Standards in Mathematics, all at exactly the same time! Even in states such as Alaska or Texas that are not adopting the Common Core Standards, the transition to deeper conceptual levels of learning in mathematics has been emphasized. One example is the new Texas educational standards, which were initiated in 2011. In short, almost everything seems to be in transition in mathematics instruction today, regardless of where one teaches.

Further, the very concept of differentiated instruction is itself being redefined (see the discussion in Chapter 1), and I, among others, are interpreting many of the innovative instructional practices, such as the flipped math class and project-based learning, as different iterations of differentiated instruction (Bender, 2012a; 2012b). Like the changes mentioned above, this transition in the very fabric of differentiated instruction will impact how virtually all teachers teach mathematics.

In this context of change, I've made a concerted effort to pull these changes into a meaningful framework, and make these things interpretable from the practical point of view to mathematics teachers. Those teachers are in the vanguard of instruction and face nearly impossible demands on their time. Thus, the teachers on the front lines of mathematics instruction need a resource that provides research-proven, highly practical instructional ideas, without wasting a great deal of time on instructional theory, and this work is intended to meet that need.

## **BOOK AND CHAPTER ORGANIZATION**

The current book has seven chapters, as described below. Each chapter focuses on one aspect of differentiated instruction, and most include a strong emphasis on technology in the classroom. Further, each chapter presents a continuing narrative in text, as well as additional information on various topics that did not seem to fit within the text itself. Generally that additional information is presented in numbered “boxes.” Also, each chapter presents specific instructional strategies and tactics for the general education mathematics class, and those are called “Teaching Tips” and appear in number order. The book is intended to be digested as a whole, and I frequently refer to topics covered in previous chapters. For example, the case study RTI examples in Chapter 7 are based on instructional strategies described in previous chapters.

## **CHAPTER DESCRIPTIONS**

### **Chapter 1: Differentiated Mathematics Instruction**

This chapter is an introduction to the “New Differentiated Instruction” and also briefly introduces the Common Core Standards in Mathematics and the eight Standards for Mathematical Practice. The focus of Common Core Mathematics is described in terms of procedural fluency, conceptual understanding, and application of mathematical processes for problem solving in real-world contexts. Next, the chapter presents the original concept of differentiated instruction, and the brain-compatible research supportive of that concept, and then discusses five factors that have created a new understanding of differentiated instruction. The focus on multiple intelligences that originally characterized discussions of differentiated instruction has been de-emphasized somewhat, by introduction of other learning style/learning preferences perspectives, and a variety of brain-compatible instructional strategies in mathematics are presented.

### **Chapter 2: Differentiated Instructional Models: Lesson Modification and Learning Centers for Mathematics**

While this is not a book on instructional theory, teachers do need to understand both the theory (as discussed in Chapter 1) and the practice of differentiated instruction in mathematics classes. This chapter focuses on the “how to do it” of differentiated instruction, by presenting two historic models for differentiation: modification of the traditional whole-group lesson plan, and learning centers for differentiating mathematics. In particular, learning

centers in mathematics fluency, operations, measurement, and problem solving will be described as will a model by which learning centers become the primary basis for all mathematics instruction, rather than merely an “add-on” to the traditional math class.

### **Chapter 3: Flipped Mathematics Classes and Project-Based Learning: New Differentiated Instructional Models in Mathematics**

This chapter is completely new, emphasizing once again the changes ongoing in mathematics education. Two new models for organizing mathematics instruction—each of which is interpreted herein as exemplars of differentiated instruction—are presented: the flipped mathematics class and project-based learning. Technology plays a key role in each of these instructional innovations and will be stressed in this chapter. Initially the flipped classroom will be described as turning the traditional lesson plan upside down, by requiring students to undertake initial instruction via self-study, and turning the math class into something resembling a math lab. The *Khan Academy* self-study mathematics curriculum will be described at length, along with specific guidelines on how teachers (referred to as coaches in that particular curriculum) may use that tool in mathematics classes. That is a curriculum focused on procedural competency rather than deeper conceptual understandings or applications of mathematics in problem-solving contexts. Of course, all students need deep conceptual understanding and application/problem-solving skills, but in spite of that limitation, this curricular option will be useful for many students. Next, project-based learning will be described at length, as the model for what happens in the differentiated math class, once students are receiving initial instruction in mathematics via self-study in the flipped classroom model.

### **Chapter 4: Strategies for Differentiating Early Math Instruction**

Within the context of both the Common Core State Standards and the four models for differentiated instruction described in Chapters 2 and 3, this chapter presents a discussion of number sense in the primary grades, followed by discussion of differentiated instructional strategies. Technology tools such as animation (using Voki avatars), and educational games in mathematics to heighten interest in and motivation for mathematics, are described and recommended. Instructional tactics such as CRA, errorless learning, time delay, and classwide peer tutoring are also described at length as effective tactics for differentiation and for

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increasing students' enjoyment of mathematics. Finally, a differentiated lesson plan is presented, with specific recommendations of how a primary teacher might differentiate his or her class, with time allocations recommended for activities such as Khan Academy, guided math instruction, or computer-based gaming.

#### **Chapter 5: Strategies for Differentiating Instruction in Grades 3 Through 6**

This chapter presents strategies for differentiating instruction in the middle elementary grades. Initially, a constructivist perspective is described as a strong basis for developing deeper understanding of mathematics concepts, and that is followed by a discussion of scaffolded instruction in math. In addition, this chapter will include several new technology options for mathematics instruction, including using blogs and wikis in mathematics instruction to foster creative exploration of math concepts. Other strategies described include process mnemonics in math, guided visualization, using cue words in problem solving, and word problem maps. Again, a differentiated lesson plan is presented, with specific recommendations for elementary teachers and with time allocations recommended for various differentiated activities, building on the differentiated lesson plan presented in Chapter 4.

#### **Chapter 6: Strategies for Differentiating Instruction in Grades 6 Through 8**

This chapter focuses on differentiating mathematics instruction in the upper elementary and middle school grades. The chapter continues the technology emphasis, by focusing on collaborative social learning using social media tools such as Facebook, Twitter, and Ning for instruction. Next, Metacognitive Theory is presented as the basis for cognitive strategy instruction in mathematics, and a variety of cognitive strategies are presented, including RIDD, STAR, PASS, and schema-based instruction for problem solving.

#### **Chapter 7: Differentiated Assessments and Response to Intervention**

This chapter is totally new and begins with a brief description of the development of the Common Assessments associated with the Common Core, to be implemented in the 2014–2015 academic year. Next, the chapter presents an array of differentiated assessment strategies for the

general education class, including standards-based assessments, criterion references assessment, CBM, authentic assessment, portfolio assessment, and rubric-based assessment for mathematics. Next, response to intervention in mathematics is discussed as an innovative interplay of both instruction and assessment, with a strong emphasis on universal screening in mathematics and progress monitoring for students in Tier 2 or Tier 3 math interventions. Finally two case studies for RTI in mathematics (third grade and sixth grade) are presented and discussed.

## **APPENDIX A: RECENTLY DEVELOPED OR WIDELY USED CURRICULA IN MATHEMATICS**

Several additional interventions will be discussed here and related to various assessment demands discussed in the preceding chapters. This includes descriptions of the SAS Curricular Pathways, TransMath, Accelerated Math for Interventions, SuccessMaker Math, and Vmath. These are frequently used in both Tier 1 instruction and in Tier 2 or Tier 3 interventions in mathematics, and teachers should be aware of them.

## **THE INTENT OF THIS BOOK, AND A WORD OF THANKS**

As an author and professional development facilitator, I'm proud that so many teachers have found earlier editions of this book useful and relevant. I meet many teachers each year who have used the teaching ideas from the book, and I continue to conduct scores of workshops yearly and have had the honor of working with thousands of teachers across the nation, the Caribbean, and in Canada.

In each of those workshops, I invariably learn some teaching idea or strategy that I usually share in the next book or workshop on this topic. Moreover, I stand in awe of the job mathematics teachers have done and continue to do, many of whom teach in very challenging situations. I've recently worked with rural schools from Tennessee to Michigan, Oregon, Washington, Ohio, Montana, and Bermuda, as well as inner city schools in Atlanta; Trenton, New Jersey; El Paso and San Antonio, Texas; and Manhattan, just to name a few. I've worked with teachers on Native American reservations from Albuquerque to Billings, Montana, and with charter schools in North Carolina as well as in the Pennsylvania oil country, and from the Silicon Valley to Detroit, to Maine.

In almost every situation I find a highly dedicated group of individuals seeking nothing more than to find new and innovative ways to excite

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students about learning mathematics. It has been, and continues to be, my honor to work with these teachers, and as this book moves into a virtually new, third edition, I want to say thanks to each of them, each of you, for ideas you share with me, and the excitement about teaching that I see in their, and in your eyes. For that reason, I'd like to dedicate this book to mathematics teachers everywhere. In this challenging field, we are teaching a topic focused on the very basic of understanding much of our universe, and few topics could ever be more important.

Also, I do invite teachers to communicate directly with me on this book topic if you so desire ([williamb@teachersworkshop.com](mailto:williamb@teachersworkshop.com)). Share a teaching idea, ask a question, or offer a comment, if you like. Give me a bit of time, but know that I do try to respond to them all. Also, you are welcome to follow me on Twitter ([@williambender1](https://twitter.com/williambender1)), where I post exclusively on educational topics, free professional development opportunities, books in education I'm writing, mathematics strategies, technology tools for the classroom, or merely on great articles or blog entries on educational topics that I want to recommend for teachers. I hope these Twitter posts are a service to you.

Again, this book is dedicated to you, and thanks for the job you do in this important teaching field!

*William N. Bender, PhD*