

INTRODUCTION

If you are like most beginning teachers, you are excited to embark on your career. You may envision your classroom as a place where students engage with mathematics, where they learn important content and are inspired to do their best. But you may also worry about how your teaching will actually play out—how you and your students will interact and what they will learn. We wrote this book for beginning middle and high school teachers who want to grow and improve throughout their first years in the profession.

You have chosen a profession that is both familiar and unfamiliar. With your years spent as a math student, along with your experiences in teacher education, teaching math is familiar to you. As a student, you spent hours in math classrooms, observing what teachers did and said and how that affected students. Perhaps you completed a teacher preparation program, succeeded in student teaching, and got certified to teach mathematics at the middle or high school level. You probably know what kind of math teacher you want to be—and do not want to be. You feel well prepared.

During your first years of teaching, though, you will probably find unfamiliar aspects of teaching math that you had never thought about. What do math teachers do when students do not “get” the lesson? What about students who struggle with math they supposedly learned in elementary school? Or absent students who need to make up work? How do teachers decide where students should sit? How do math teachers figure out whether their teaching is effective? Some students will have different ideas about what they should be doing in mathematics class, what is important about school, and how they should engage with the content and one another. Like most new teachers, you may find that what seemed familiar is full of the unknown.

HOW THIS BOOK HELPS BEGINNING TEACHERS

We wrote this book to help you navigate this recognizable yet unfamiliar terrain. This book will be especially helpful to new teachers of middle and high school mathematics.

Demystifying teaching

Many in the United States believe that teaching is simply a matter of talent and intuition, that great teachers come by it naturally—that they were “born to teach.” Akin to this belief is that bad teachers are simply not dedicated, talented, or smart enough. We hope to debunk this belief so that it does not block your effectiveness and improvement.

Teaching is incredibly complex: what appears simple is extremely difficult. Furthermore, many aspects of teaching are quite unnatural and run counter to “normal” interaction in the adult world (Ball 2007). For instance, mathematics teachers often pretend not to understand what a student is saying in order to force the student to more clearly explain his or her thinking. Such interaction does not happen in normal adult conversations. Similarly, when people outside a classroom ask for our help, we would not direct them to ask their neighbor first, yet that is a common tactic in student group work. Outside the classroom, we would never do many of the things we do to support our students; it would be unnatural.

Moreover, much of what a teacher does is invisible to outsiders. Students see teachers handing out worksheets, checking homework, showing how to do a mathematical procedure, asking and answering questions. Students do not see the planning, the bureaucratic work (such as organizing papers and grading), or the thinking that goes into decisions teachers make in the classroom and in creating assignments. This book makes some of those invisible aspects of teaching more visible and then offers strategies to make this work more manageable.

Focus on mathematics

This book focuses on the teaching and learning of middle and high school mathematics. Dozens of self-help and how-to books are available for beginning teachers. These books exist mainly to help beginning teachers with general issues, such as creating a safe and challenging academic culture, organizing the classroom, engaging students, and setting high expectations. Although helpful, these books lack a focus on any particular content area—they do not address specific challenges and needs of middle and high school mathematics teachers.

We wrote this book to address important issues of mathematical teaching and learning, while offering information and advice about diverse issues that new teachers need to master quickly. Especially for secondary school teachers, who teach mainly just one subject, situating concerns of new teachers within mathematics is important and useful—and mostly absent from teacher how-to books.

Linking theory and practice

This book helps beginning mathematics teachers by linking theory and practice in a new way. First we describe what it means to know mathematics, how students come to know mathematics in powerful ways, and how teachers can orchestrate such learning. We then connect these (theoretical) ideas about content, learning, and teaching to advice about teaching moves and classroom routines that support learning.

In a well-known mathematics education article, Skemp (1976) argued that the ability to perform mathematical procedures, devoid of any greater set of ideas or connections, is like being able to follow directions from point A to point B. As long as you do not make a wrong turn, or no one closes a street for construction, you can find your way. However, if you make a wrong turn, or something blocks your way, you are completely lost. In contrast, understanding mathematical concepts and connections between representations, ideas, and strategies is like having a map. A map enables you to chart various routes from point A to point B and to deal with unexpected obstructions. Truly understanding mathematics offers a similarly powerful tool to solve mathematical problems.

We feel the same way about teaching. A list of suggestions is akin to a set of directions, but if your students do not respond as expected, or if your school has a culture that does not support those suggestions, then you may get lost. If you have a larger set of understandings about teaching and learning mathematics, you can use them to chart your own course and make informed decisions about what you and your students do in your mathematics classroom. We offer directions, though in the context of a

larger map, so that you can adjust them to your context while staying true to larger goals and understandings about teaching and learning.

EQUITY IN MATHEMATICS LEARNING AND TEACHING

“Excellence in mathematics education requires equity—high expectations and strong support for all students” (National Council of Teachers of Mathematics [NCTM] 2000, p. 11). This statement of the Equity Principle in *Principles and Standards for School Mathematics* captures an overarching theme for this book: that effective mathematics teaching supports all students—regardless of personal characteristics or background—to develop a deep understanding of mathematics.

Issues of equity in learning and teaching mathematics are complex and lie at the intersection of complicated histories, group and individual identities, personal beliefs, and political ideologies. Although we acknowledge this complexity, untangling these issues is beyond the scope of this book. But this book does highlight the influence that teachers wield in ensuring that all middle and high school students have access to learning interesting and important mathematics.

Teaching practices that account for equity support students in developing connected mathematical knowledge. Students must engage in the mathematical processes of reasoning, representing, solving problems, communicating, and making connections (chapter 2), and you must hold high expectations as your students do so. Equitable teaching practices are supported by viewing teaching through the triangle of instruction (chapter 3) and include cultivating a positive learning community (chapter 4), choosing accessible and rich tasks (chapter 5), planning for and enacting inclusive instruction (chapters 6 and 7), creating clear expectations for positive behaviors (chapter 10), and working with struggling students (chapter 11, especially the section on redefining mathematical success).

Your teaching decisions greatly influence your students’ experiences in learning mathematics, their access to interesting and important mathematics, and ultimately how they come to know mathematics. This book presents both a vision of mathematics teaching and strategies for realizing that vision that promote equitable learning environments for all middle and high school students.

STRUCTURE OF THIS BOOK

The structure of the book flows from a link between ideas (theory) and suggestions (practice). First, we offer beginning secondary mathematics teachers a set of ideas about learning and teaching that can guide instructional decisions. Later chapters deal with aspects of teaching. Each chapter offers guiding principles that connect the content to the larger framework. We then offer habits of practice—practical suggestions that align with the guiding principles and with the overarching framework of teaching and learning mathematics. These habits of practice are based on our own experiences as mathematics teachers as well as our experiences working with mathematics teachers over the past twenty years. As appropriate, we also draw on work

done by other mathematics educators. In drawing on a variety of sources, we give you advice grounded in solid research and practical experience.

The book is organized in four sections. Section I (The Big Picture) begins with a visit to a prealgebra classroom. The vignette in chapter 1, interspersed with reflective questions, establishes the kinds of mathematics learning and teaching that you will encounter through this book. Chapters 2 and 3 describe connected knowledge of mathematics, the fundamental role of the NCTM (2000) Process Standards in learning mathematics, and the kind of teaching that lets students develop connected mathematical knowledge.

Section II (Laying the Groundwork) focuses on how you can create a successful mathematics classroom. Chapters 4 and 5 present strategies to forge collaborative relationships with more experienced colleagues; learn about students, curriculum, and context before the students arrive; and envision and create a classroom community to support student learning during the first weeks of school.

Section III (The Lesson Cycle) focuses on the core activities of teaching: planning, enacting, and reflecting on instruction. Chapters 6–9 cover mathematical problems/tasks/activities, effective planning for instruction, enacting instruction that supports students in building connected knowledge of mathematics, and reflection as a tool for improvement.

Section IV (More Elements of Effective Teaching) focuses on elements of effective teaching not contained in sections II and III. Chapters 10–15 address group work, assessment, classroom management, and teaching struggling students, as well as technology, interacting with parents/guardians, and standardized testing and test prep.

TEACHING AND THE COMMON CORE STATE STANDARDS FOR MATHEMATICS

Over the past twenty-five years, the mathematics education community has created standards for learning and teaching mathematics in U.S. schools (NCTM 1989, 1991, 2000, 2006). Through these standards, the community has attempted to define broadly what content students should learn at what times, the kinds of thinking at the core of what it means to know and be able to do mathematics, and practices teachers can use to support such learning.

More recently, the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) published the *Common Core State Standards for Mathematics* (CCSSM; NGA Center and CCSSO 2010). CCSSM addresses two different topics. First, CCSSM describes what mathematical topics students should master at specific times during their schooling. For instance, by the end of fourth grade, students should be able to “add and subtract mixed numbers with like denominators” (p. 30), and some time in high school they should “understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line)” (p. 66). Second, CCSSM contains Standards for Mathematical Practice, which describe what it means to know and understand math-

ematics deeply, as well as the kinds of thinking and behaviors that should be the larger goals of mathematics instruction in all grades:

- 1 Make sense of problems and persevere in solving them.
- 2 Reason abstractly and quantitatively.
- 3 Construct viable arguments and critique the reasoning of others.
- 4 Model with mathematics.
- 5 Use appropriate tools strategically.
- 6 Attend to precision.
- 7 Look for and make use of structure.
- 8 Look for and express regularity in repeated reasoning. (NGA Center and CCSSO 2010, pp. 6-8)

The writers of CCSSM stress that students should engage in these practices while learning the mathematics contained in the Standards for Mathematical Content.

Although this book addresses teaching middle and high school mathematics, it is not about mathematical content. Yet this book does connect to CCSSM. We see the Standards for Mathematical Practice as powerful descriptions of what both learning and understanding mathematical content looks like. The theory about learning and teaching in section I of this book aligns well with these practices, is inspired by much of the same research and foundational documents, and addresses many of the same core issues in mathematics teaching and learning. If you reflect on the ideas about learning and teaching mathematics, as well as use this book's suggestions in your teaching, your classroom will be a place where students engage in CCSSM's mathematical practices.

WHO SHOULD READ THIS BOOK

We wrote this book explicitly for beginning teachers of middle and high school mathematics, whom this book can help in several contexts. Newly certified mathematics teachers could read it during the summer before starting a first teaching job and find valuable information to help with those first days and weeks of school. Groups of beginning mathematics teachers could read it as part of a formal induction program. Beginning mathematics teachers struggling in their first few months could find advice to address areas of immediate concern. The book can help preservice teachers looking to prepare and learn from student teaching or who are about to move from their own training to full-time teaching. Finally, the book will help beginning teachers continue to reflect on and improve instructional practices over the first few years of their career.

OUR FIRST PIECE OF ADVICE

This book is full of suggestions to improve your teaching and thus your students' opportunities to learn mathematics. You will not be able to enact all our suggestions right from the beginning of your career, nor would we want you to. Although effective mathematics teaching is complex, improvement can come from working on one aspect of practice at a time. Many chapters present strategies to improve your practice. Choose one or two strategies to work on first and see how it goes. We hope that, in working to achieve small changes in your practice, you can create gradual, sustained growth and positive change.

This is an exciting time to be a math teacher. As a field we have learned much about how students learn and how we can support them in learning mathematics in a deep and connected way. Across the nation, mathematics teachers are working together to improve their teaching, enabling more and more students to experience mathematics as a living, powerful, creative, and elegant discipline. You are entering a profession that lets you demonstrate caring as well as engage in challenging and stimulating intellectual work of great importance: improving instruction so that all students can learn mathematics with understanding and power. Welcome aboard.