

CHAPTER 1

Introduction



At the heart of efforts to help students in Grades K–5 learn mathematics is the idea of *ambitious teaching*. It’s referred to as *ambitious* because of the substantial student learning goals that it encompasses—that all students have opportunities “to understand and use knowledge . . . [to] solve authentic problems” (Lampert & Graziani, 2009, p. 492). The Common Core State Standards for Mathematics (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) provide a powerful vision of these goals through their description of grade-level, domain-specific content standards and the cross-cutting Standards for Mathematical Practice.

We believe that the phrase *ambitious teaching* is also appropriate because teaching in ways that align with these goals is a formidable task! To help you and other teachers understand what this looks like, *Principles to Actions: Ensuring Mathematical Success for All* (National Council of Teachers of Mathematics, 2014) describes a set of eight teaching practices that serve as a foundation for ambitious teaching (Figure 1.1 on the next page). These practices are based on what we know from research about how to effectively support students’ learning of mathematics.

Figure 1.1 • Eight effective mathematics teaching practices

Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.
Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.
Use and connect mathematical representations. Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.
Facilitate meaningful mathematical discourse. Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
Pose purposeful questions. Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense-making about important mathematical ideas and relationships.
Build procedural fluency from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.
Support productive struggle in learning mathematics. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.
Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

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Ambitious teaching also requires attention to equity. Mathematics has long been considered a gatekeeper, limiting opportunities for some students while promoting opportunities for others (Martin, Gholson, & Leonard, 2010). These differences are apparent as early as kindergarten, with African American and Latinx students more likely to be in classrooms that focus on procedural aspects of mathematics and/or that underestimate these students' capacities to engage in high-level problem solving (Aguirre et al., 2017; Turner & Celedón-Pattichis, 2011). Ambitious teaching requires you to challenge these long-standing practices and provide access and opportunity for every student so that they can develop strong positive identities as learners of mathematics (Aguirre, Mayfield-Ingram, & Martin, 2013).

At the center of ambitious teaching is a focus on classroom discourse. As you facilitate meaningful discussions with students, you will typically engage in several of the effective mathematics teaching practices, including asking purposeful questions, eliciting and using evidence of student thinking, connecting to various mathematical representations, and supporting productive struggle among students as they learn

mathematics (Figure 1.1). In addition, allowing students to share their thinking with the class can help to position all students as valuable resources for learning and promote an equitable learning environment. In these ways, organizing discussions around students’ ideas becomes critical for successfully enacting ambitious instruction.

What does it take, then, to organize and implement effective discussions? In this book, we present guidelines for using the five practices described by Smith and Stein (2018) in their book *5 Practices for Orchestrating Productive Mathematics Discussions*.

The Five Practices in Practice: An Overview

The five practices are a set of related instructional routines that can help you design and implement lessons that address important mathematical content in ways that build on students’ thinking (Figure 1.2). Warning: There is actually a Practice 0, which serves as a foundation for the remaining practices—yup, this means there are six practices in total, but for historical reasons, we will still call the set “the five practices.” (In case you are wondering how this could have happened, here is the scoop: After some early articles about the five practices were published, a mathematics coach with whom Peg was working suggested to her that a practice was missing—that before teachers could engage with the five practices, they

Figure 1.2 • The five practices in practice

Practices that take place while planning for instruction		Practice 0: Setting goals and selecting tasks (Chapter 2) Specifying learning goals and choosing a high-level task that aligns with those goals
		Practice 1: Anticipating student responses (Chapter 3) Exploring how you expect students to solve the task and preparing questions to ask them about their thinking
Practices that take place during instruction but are considered while planning	Students work individually or in small groups	Practice 2: Monitoring student work (Chapter 4) Looking closely as students work on the task and asking questions to assess their understanding and move their thinking forward
	As you move from small group work to whole class discussion	Practice 3: Selecting student solutions (Chapter 5) Choosing solutions for students to share that highlight key mathematical ideas that will help you achieve lesson goals Practice 4: Sequencing student solutions (Chapter 5) Determining the order in which to share solutions to create a coherent storyline for the lesson
	Whole class discussion	Practice 5: Connecting student solutions (Chapter 6) Identifying connections among student solutions and to the goals of the lesson that you want to bring out during discussion

needed to set goals and select a task. Though this idea was already implied in the five practices, the coach persuaded Peg to make it explicit, and hence Practice 0 was born!)

Teachers often think that ambitious teaching requires you to make all your instructional decisions during instruction based on what students say and do in class. The five practices, however, help you think through all aspects of the lesson *in advance* of teaching, thus limiting the number of in-the-moment decisions you have to make during a lesson. Careful planning prior to a lesson reduces what you need to think about during instruction, allowing you time to listen more actively, question more thoughtfully, and respond more acutely.

Practice zero, *setting goals and selecting tasks*, lays the groundwork for the remaining five practices. It is essential to be clear on what you want students to learn and to choose a cognitively demanding task that aligns with those goals. Once you have the task in mind, you can move to *anticipating student responses*. Here, the purpose is to think about how students might solve the problem, what challenges they might face, and how you will respond to their thinking. One benefit to doing so is that you can develop—before class—targeted questions you might want to ask students about these different approaches.

Although the next four practices take place during instruction, you will also want to think them through carefully during planning. *Monitoring student work* involves giving students time—usually in groups—to work on the task, while you circulate among them. As you look closely at how students are progressing, you can use the questions you developed earlier to assess what students understand and to try to move their thinking forward. As you prepare to transition students into a whole class discussion, you will engage in *selecting student solutions*—deciding which solutions you want to have shared in the discussion and who should present those solutions—as well as *sequencing student solutions*—deciding how you want to order the presentation of the solutions. Selecting and sequencing require close attention to the mathematical ideas that are highlighted in different solutions and to helping all students have access to the ideas shared in the discussion. As you plan the lesson you will consider what you want to be on the lookout for as you monitor students' work, what solutions will help you surface the mathematical ideas you are targeting, and what order of solutions will provide access to all students.

The final practice, *connecting student solutions*, takes place as the discussion unfolds in your classroom. The purpose is to make explicit the connections between students' solutions and the mathematical goals of the lesson. Drawing out these connections for students is essential to ensure that students take away from the discussion what you intended. This too is something you can consider as you plan the lesson!

Together, the five practices can help you prepare for and carry out meaningful discussions with your students, discussions that revolve around the thinking of your students. And that is the essence of ambitious instruction!

Purpose and Content

The purpose of this book is to deepen your understanding of the five practices as described by Smith and Stein (2018). Toward that end, Chapters 2 to 6 comprise two parts: unpacking the practice (Part One) and challenges teachers face in enacting the practice (Part Two). In Part One, we describe in some detail what is involved in engaging in the practice, provide questions that you should ask yourself as you undertake the practice, and use an example from an elementary classroom to illustrate the components of the practice. In Part Two, we highlight aspects of the practice that have proven to be challenging for teachers, suggest ways you can address the challenge, and provide examples of how teachers are overcoming the challenge.

Throughout these chapters, we encourage you to actively engage with the content. Toward this end, we have created three types of opportunities for engagement: *Pause and Consider* questions (reflection), *Analyzing the Work of Teaching* activities (analysis), and *Linking the Five Practices to Your Own Instruction* assignments (implementation). The *Pause and Consider* questions give you the opportunity to think about an issue, in some cases drawing on your own classroom experience, prior to reading more about it. The *Analyzing the Work of Teaching* activities engage you in analyzing aspects of teachers' planning for and enacting of grade-level lessons. The *Linking the Five Practices to Your Own Instruction* assignments provide you with the opportunity to put the ideas discussed in the chapter to work in your own classroom.

Throughout the book we have included a range of different types of examples drawn from elementary classrooms to illustrate aspects of the five practices and the associated challenges. The video excerpts and related classroom artifacts—featuring the three teachers who are introduced later in the chapter—provide vivid images of real teachers using the five practices in their efforts to orchestrate productive discussions. The narrative examples that appear in the book are based on our experiences working with elementary school teachers through professional development initiatives and teacher education courses. These examples are intended to provide insights into specific challenges teachers face when engaging in the five practices and are not exact representations of a specific teacher's practice. Each of these teachers has been given a pseudonym (e.g., Jada Turner, Carmen Ortiz, Michael McCarthy, and Jesse Samson featured in Chapter 2). The video and narrative examples are not intended as exemplars to be copied but rather as opportunities for analysis, discussion, and new learning.

If you are coming to the five practices for the first time, you might find it helpful to start with *5 Practices for Orchestrating Productive Mathematics Discussions* by Peg Smith and Mary Kay Stein (2018). Smith and Stein's book offers a wonderful, easy-to-read introduction to and overview of the five practices. The book you are reading now takes a much deeper dive into the five practices, asking you to stop and think, watch videos of the practices in action, and consider what is challenging about each practice. While you can certainly start here, the overview of the five practices provided by Smith and Stein (2018) may help you get the big picture before taking a deeper dive!

This book will be a valuable resource for looking closely at what it takes to be successful with the five practices. For each practice, we offer key questions, which identify the essential components of the practice. We suspect these questions will enhance your understanding of the practices and perhaps provide new information about the goals and expectations for each practice. This book also describes challenges associated with each practice that teachers we have worked with have encountered, as well as specific suggestions for successfully addressing these challenges. If you have already been using the five practices, we suspect that some of these challenges may be familiar to you and that these discussions will be particularly useful.

Classroom Video Context

In identifying teachers to feature on video, we felt that it was important to select a school district that would feel authentic to readers—one that faced challenges of diversity, poverty, and student performance but was working hard to improve mathematics teaching and learning. We selected Metro Nashville Public Schools (MNPS) for several reasons—the district met our authenticity criteria. Victoria Bill, the second author, had been working in the district for several years, and the district was willing to be featured in this book.

MNPS is an urban district located in Nashville, Tennessee. MNPS has a diverse student population K–12 (as shown in Figure 1.3) with 50.6 percent of students qualifying for free or reduced lunch and 15.68 percent of students classified as English Language Learners. The nearly 85,000 students attend 76 elementary schools, 31 middle and K–8 schools, and 17 high schools. In addition, there are also 31 charter schools and 17 nontraditional and Special Education schools.

Figure 1.3 • Race/ethnicity of Metro Nashville Public Schools students

American Indian/Alaska Native	0.4%
Black	43%
Hispanic	23%
Asian/Pacific Islander	4%
White	29%

Source: Tennessee Department of Education, 2018.

As stated on its website (<https://www.mnps.org/about-mnps/>), MNPS is committed to becoming “the fastest-improving urban school system in America, ensuring that every student becomes a life-long learner prepared for success in college, career and life.” The mathematical mission for the district is for students to have the opportunity to reason mathematically, communicate their ideas with others, and learn to value mathematics through rigorous instruction on a daily basis.

Jessica Slayton, director of mathematics for MNPS, explains what it will take to make this vision a reality in classrooms:

Students need opportunities to communicate their ideas and this means teachers have to be able to facilitate classroom discourse. So we’re providing structures and supports for our teachers so that they can effectively facilitate these conversations in their classrooms. The five practices are so essential because discourse is at the heart of our mission.



A District Engages in the Five Practices



Video Clip 1.1

In Video Clip 1.1, Jessica Slayton, director of mathematics, explains the district’s efforts to support teachers in facilitating classroom discourse through their use of the five practices.



Videos may also be accessed at
resources.corwin.com/5practices-elementary



To read a QR code, you must have a smartphone or tablet with a camera. We recommend that you download a QR code reader app that is made specifically for your phone or tablet brand.

As a result of the professional development in which teachers have engaged, Mrs. Slayton has seen many changes in teachers' practice. She explains:

The first thing that comes to mind is their belief in the students. We had a lot of timid teachers at first, and they didn't know if the students were actually capable of the mathematics for their grade levels. We said, "Give this a try. Try the five practices, see if you can anticipate, and determine how to support the students." Now that they've done that, they see it: "Oh yes, my students are capable." It doesn't matter if it's a student with limited English; we know how to support them because we've anticipated what some of the struggles might be.

Another change that we've seen is really the self-awareness in planning. If I want to get this out of my students, if this is my mathematical goal, I need to be able to press students towards that goal, which means I need to plan how to do that. It's not going to happen by accident. Planning on your own is challenging. One person might not be able to anticipate five different solution strategies, but working with peers in a grade-level team there are different perspectives and they're able to collaborate, and they can build lessons together that are more meaningful for their students.

Meet the Teachers

The video recordings and related classroom artifacts featured in this book are drawn from the work of three Grade K–5 teachers in MNPS—Olivia Stastny, Andrew Strong, and Tara Tyus. The lesson taught by Tara Tyus will be used in Part One of Chapters 2 to 6 to unpack the focal practice. By focusing on the same teacher across chapters, you will have a coherent picture of instruction in her classroom and a better understanding of how the practices provide synergy. The lessons taught by Olivia Stastny and Andrew Strong will be used in Part Two of Chapters 2 to 6 to provide illustrations of how specific challenges can be addressed.



Olivia Stastny has been teaching at Una Elementary School since she began her career four years ago. She has a bachelor's degree in elementary education and a master's of education in curriculum and instruction. She wanted to become a teacher so she could help all students grow to their fullest potential—academically, socially, and emotionally.

Olivia believes that her third grade students should have daily real-life, rigorous opportunities in the mathematics classroom, allowing them to achieve their greatest abilities. Toward this end, she feels it is important to pick a task for which there is a low floor so that students can enter the task and a high ceiling so that there's the potential to really accomplish something that is mathematically important. Embedded in this is the

notion that students could solve the task in multiple ways, because students come to class with different knowledge and experiences, while making it possible for them to also advance their learning.

Olivia sees the five practices as playing a vital role in preparing for instruction. She explains:

I can choose the best task for my students and plan, plan, plan, which is one of the biggest parts of doing the five practices. Planning is everything! The teacher needs to know the goals of the lesson, anticipate the solutions, think about possible sequencing, and how it is all going to connect, all before the lesson even starts.



Andrew Strong has been working in Metro Nashville since he started teaching 16 years ago. He has a bachelor's degree in film production and a master's degree in elementary education. He is currently teaching fifth grade mathematics at West End Middle School (Grades 5–9), where he has been for the past two years. He became a teacher because he believes there is nothing more important to which one can dedicate their life, and he “enjoys the heck out of it.”

Andrew feels it is his mission to love his students, instill in them a confidence and joy for the learning process, and provide them with tools they will need to find success wherever they seek it. He wants his students to learn to think and to take responsibility for their own learning so that they will become responsible adults who can think for themselves. This, he feels, is desperately needed in the world, and it gives him a deep sense of purpose.

Andrew sees the five practices as a guideline for organizing his thinking about a lesson. He explains: “This is a solid way to get kids to grapple with their thoughts and then to actually come away with the understanding that they need.”



Tara Tyus teaches at Una Elementary School, a position she has held since she started teaching six years ago. She has an undergraduate degree in early childhood education and a master's degree in curriculum and instruction, with a focus on elementary education. Tara believes her mission is to help students become their best selves by engaging them in lessons that make them think.

Tara wants her first-grade students to develop an understanding of the concepts underlying the procedures they are learning so that they are not mindlessly following a series of steps. She explains: “It is necessary to use mathematical tasks so students can learn how to think critically when problem solving. In doing so, they learn multiple solution paths and are able to determine efficient strategies to help them solve problems successfully later. Thus, knowledge learned is retained and not simply regurgitated.”

The five practices help Tara plan and facilitate discussions around high-level mathematical tasks. She explains:

Students love high-level tasks—to explore and have fun with mathematics. As a teacher, the five practices are so important because they help me get prepared for instruction and make sure I accomplish what I set out to do. Without the five practices, lessons could get very chaotic.

These three teachers are making their teaching practice public so that others can learn from their efforts. Hiebert, Gallimore, and Stigler (2003) argue that we must respect teachers for being “brave enough to open their classroom doors” (p. 56). To honor their courage, as you read about and view excerpts from their classrooms, we encourage you to avoid critiquing what you see or discussing what the teacher “should have done.” Instead, our goal is to use the access we have been given as an opportunity for learning—for serious reflection and analysis—in an effort to improve our own teaching in ways that open up new opportunities for our students to learn.

Using This Book

You will likely get the most out of this book if you are committed to ambitious teaching that provides students with increased opportunities to engage in productive discussions in mathematics classrooms. Through engaging with the ideas in the book, you will learn much about how to increase students’ engagement in and learning from classroom discussions.

This book can be used in several different ways. You might read through the book on your own, stopping to engage with the questions, activities, and assignments as suggested. Alternatively, and perhaps more powerfully, you can work through the book with colleagues in professional learning communities, department meetings, or when time permits. The book would also be a good choice for a book study with a group of peers interested in improving the quality of their classroom discussions. You might also encounter this book in college or university education courses for practicing or preservice teachers or in professional development workshops during the summer or school year. We will explore more ideas about ways to make the five practices central to your instruction in Chapter 7.

Norms for Video Viewing

The video excerpts that accompany this book are intended to provide authentic examples from elementary classrooms on which to base discussions of the five practices. To take full advantage of these examples, we encourage you to consider the following three norms for video viewing. These norms are based on recent research that documents how video can support teacher learning and reflection (Sherin & Dyer, 2017; Sherin & van Es, 2009).

Focus on student sense-making. The majority of the video clips that you will watch in this book focus on students. That is intentional. While the five practices describe actions that you as the teacher will take, this work involves looking closely at what students do and say. The videos thus provide an opportunity for you to do just that outside of the immediate demands of teaching.

As you explore students' actions in the videos, we encourage you to look beyond simply whether a student's idea is correct or incorrect. Instead, examine what it is that the student understands. What is the student's idea? Where does it come from? Why is it sensible, given what the student understands? Focus on what it is that makes sense about the students' thinking.

Be specific about what you notice. Much of the value of video viewing is the sense that you can slow down classroom interactions and have the time to notice what is taking place in a detailed way. In addition, with video you can often focus on just a subset of events and look closely, for example, at what a particular student is saying and to whom, what gestures or drawings the student is making, and more.

As you view the video excerpts, we encourage you to be specific about what you notice. Provide detailed evidence to support your claims about what is happening. Explain what it is you see in the video that leads you to a particular interpretation.

Consider alternative interpretations. As you watch the video, you may find yourself quickly making assumptions about what is taking place and why. As teachers, we must often respond quickly, diagnosing student confusions, responding to student questions, and making changes in the direction of a lesson. Video, however, provides the luxury of time. Use this to your advantage!

Once you have an idea of what you think is taking place in the video, look for alternatives. How else might you understand what is happening? This is particularly important when examining students' ideas. Rather than assume you know the reason behind a student's strategy or statement, look for alternatives. Considering alternate interpretations is important because when we assume we understand what a student means, we often limit ourselves to what we have heard from students previously.

Getting Started!

You are now ready to begin a deep dive into the five practices. In the next five chapters, you will learn more about the practices. We encourage you to keep a journal or notebook in which you can respond to questions that are posed and make note of questions you have. Such a journal can be helpful in conversations with other teachers or in reflecting from time to time about how your thinking is evolving and changing.