

Chapter 1

Coaching for Mathematical Proficiency

Ultimately, the goal of every mathematics coach is to improve the chances that students become *competent* and *confident* in mathematics. This simply stated purpose is anything but simple to accomplish. Each coach or leader works within the context of his or her own setting to decide how to best focus efforts toward this goal. In one setting, a coach might focus on helping teachers to learn content more deeply, considering the way in which mathematical ideas are connected within their grade or course and across grades or courses. In another setting, the focus may be on teaching, with efforts to consider how particular instructional moves provide or prevent opportunities for each student to engage with the content. If you have been coaching for a while, you might feel that your work is anything but focused, with various initiatives happening in different schools or classrooms. But everything that you are doing is in some way or another focused on **mathematical proficiency** for every student. The purpose of this book is to help you, the leader (and to help you help your teachers), to see the connections between your **professional learning** activities, teaching, and student learning. *Everything You Need for Mathematics Coaching: Tools, Plans, and a Process That Works for Any Instructional Leader* might be thought of as your *Reader's Digest*, providing you with a shortened version of critical topics in coaching and teaching (e.g., facilitating discourse) and a collection of resources to assist you in working on that topic.

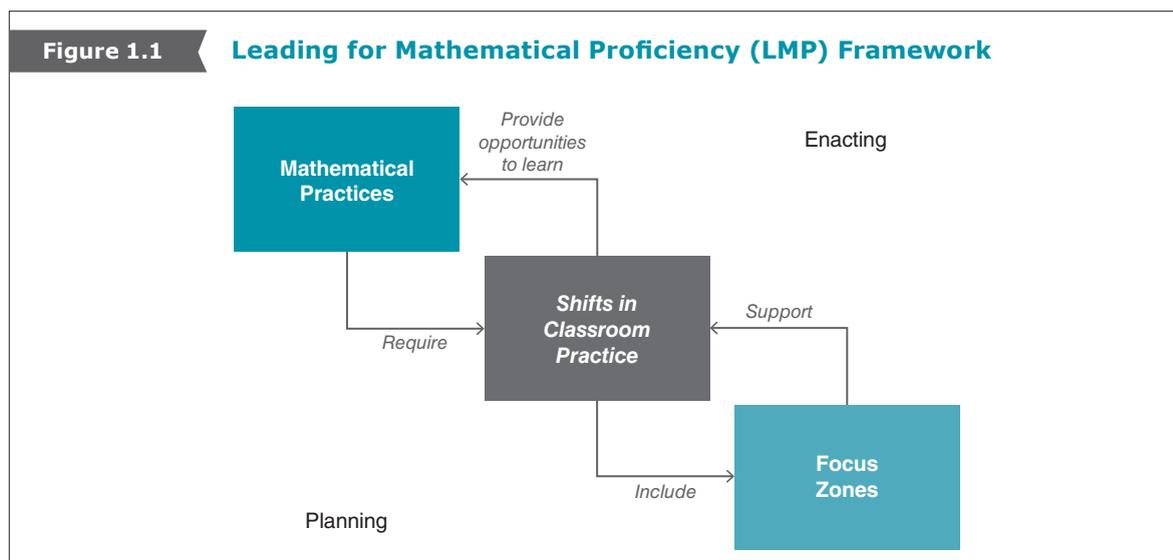
Recognizing the busy lives of coaches, we try to boil down the discussion of these topics to the bare necessities, offer you a menu of places to go for more information, and provide a collection of tools that can be used for professional learning or for one-on-one coaching (the Preface elaborates on each of these features, and each chapter offers an opening note to guide you to what you need). In the chapters that follow, we zoom in on specific topics; in this first chapter, that abbreviated discussion is about the big picture. The second chapter also focuses on the big picture, with an overview addressed to teachers (that you can download and share), along with tools to support their learning. The remainder of Chapter 2 is addressed to you, the coach or instructional leader.

Leading for Mathematical Proficiency [LMP] Framework

It is natural, even wise, to seek justification and rationale when asked to change. When thinking of a change in teaching practice, there are many possible ways to justify it. Learning of research that something worked, hearing about a situation in which a practice “worked,” or hearing a testimonial about an idea that really engaged students are ways that some teaching practices get picked up and

tried. We would like to suggest that fundamentally we must start at what it is we want students to be able to do—not which standards they will learn, but what we want them to do if we are truly preparing them to do mathematics. What it means to do mathematics is best described in the Mathematical Practices (NGA & CCSSO, 2010).

The Leading for Mathematical Proficiency (LMP) Framework (see Figure 1.1) frames the goals of professional learning on developing mathematical proficiency in all students. The LMP Framework is dually focused to both help you, as coaches, see how pieces of your efforts fit together in a purposeful manner and to help you, as facilitators, communicate these connections to teachers and other stakeholders. The bottom line is that we must regularly revisit these connections to ensure that there is a clear purpose and cohesion to the activities that are occurring.



Each of the major components of the LMP Framework has lists of more specific targets. Specifically, there are eight Mathematical Practices and eight *Shifts in Classroom Practice*. A coach may choose to focus on any number of focus zones, but we have identified eight. These are related to each other in complex ways and are presented in Figure 1.2 as an advanced organizer of the discussion of these major components.

Mathematical Practices

From the Common Core State Standards for Mathematics (NGA & CCSSO, 2010), and now included in many state standards, these expectations for students must be the ultimate goal of **mathematics coaching**. **Mathematical practices** describe what **mathematically proficient students** are able to do, and those descriptions will endure even if the labels are changed. Figure 1.3 lists each Mathematical Practice, along with excerpts from the descriptions (only the sentences beginning with “Mathematically proficient students ...” are included).

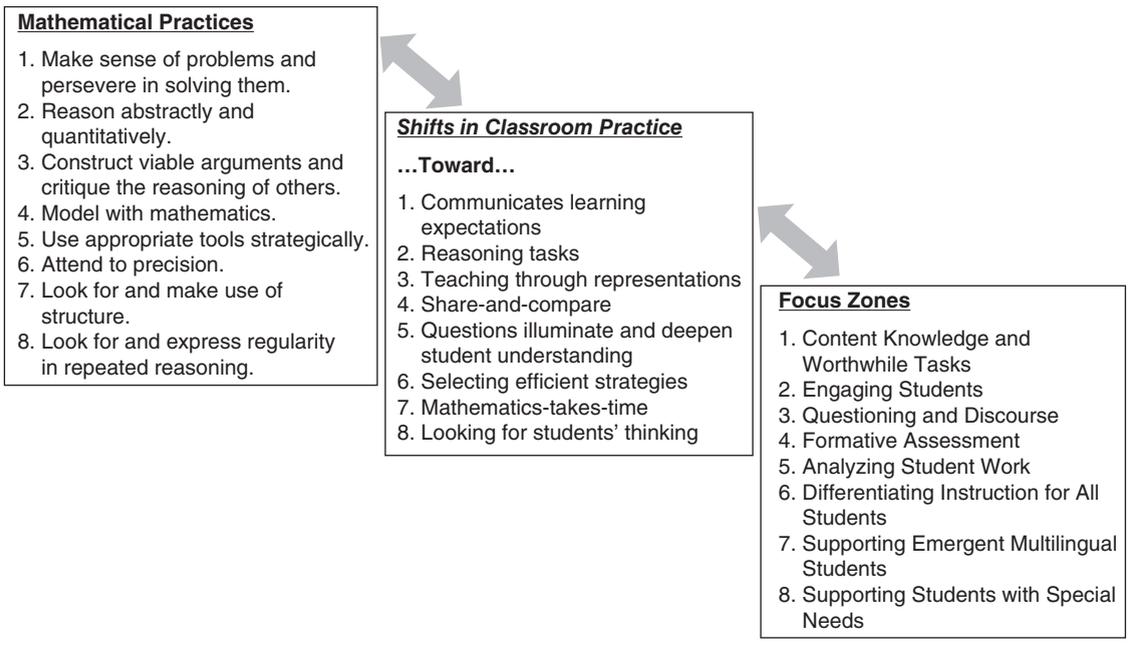
To place the Mathematical Practices as the goal of professional learning, as in the LMP Framework, professional learning must begin by asking,

What does each of the Mathematical Practices look like in action?

As New York Yankee player and coach Yogi Berra put it, “If you don’t know where you are going, you’ll end up someplace else.” This advice for baseball also applies to instructional coaching! Related to the Mathematical Practices, you have to be sure that there is a shared understanding of what a student is doing if the student is modeling with mathematics (Mathematical Practice 4) or looking for structure

Figure 1.2

At-a-Glance Elements Within Each Component of the LMP Framework



(Mathematical Practice 7). The Mathematical Practices provide specific descriptors or “look fors” related to student actions, and these can and should be tied to the content that students are learning. In the Appendix, you will find the Mathematical Practices & Student Look Fors Bookmark, providing an at-a-glance resource for **professional development, lesson cycles, and personal reference.**



You can also download the bookmark at resources.corwin.com/mathematicskoaching.

Even if the list of eight Mathematical Practices is familiar, being able to think about what they look like for a first grader or a tenth grader is not obvious. If teachers within a group have different interpretations of modeling, for example, then they are working toward different goals—which can make the work of PLCs confusing or ineffective. And if a teacher views these practices differently than the coach, it can interfere with the effectiveness of a lesson cycle. Chapter 2 provides numerous tools for helping to build a shared understanding of what the Mathematical Practices look like in action, and Chapter 12 provides several professional learning activities to engage groups of teachers in developing a shared understanding of these practices.

Shifts in Classroom Practice

With a vision of what a Mathematical Practice (or several Practices) looks like in terms of student actions or behaviors, the question becomes this:

How can we (as teachers and coaches) provide optimal learning opportunities for students to become mathematically proficient?

Creating opportunities for students to become mathematically proficient (i.e., demonstrate the Mathematical Practices) requires implementing teaching practices that focus on helping students acquire these practices while simultaneously working on creating deep understanding of the content. *Principles to Actions: Ensuring Mathematical Success for All* (PtA; NCTM, 2014) delineates eight **Effective Teaching Practices** (see Figure 1.3 on the next page). These practices are grounded in

Figure 1.3

Mathematical Practices: What Mathematically Proficient Students Are Able to Do (NGA & CCSSO, 2010)

- 1. Make sense of problems and persevere in solving them.** Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. . . . Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. . . . Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?”
- 2. Reason abstractly and quantitatively.** Mathematically proficient students make sense of quantities and their relationships in problem situations.
- 3. Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. . . . Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is.
- 4. Model with mathematics.** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. . . . Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.
- 5. Use appropriate tools strategically.** Mathematically proficient students consider the available tools when solving a mathematical problem. . . . Mathematically proficient students are sufficiently familiar with tools appropriate for their grade or course and make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations.
- 6. Attend to precision.** Mathematically proficient students try to communicate precisely to others.
- 7. Look for and make use of structure.** Mathematically proficient students look closely to discern a pattern or structure.
- 8. Look for and express regularity in repeated reasoning.** Mathematically proficient students notice if calculations are repeated and look both for general methods and for shortcuts.

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research, which is summarized not only in that important book but also in related reviews of research (Spangler & Wanko, 2017; see *Books* in the *Where to Learn More* section, later in this chapter).

For each of these Teaching Practices, we developed a *Shift in Classroom Practice*. A *Shift* succinctly describes the Teaching Practice along a continuum (see Figure 1.4). Teaching is a learning endeavor. There is always some way we can adapt our practice in order to better meet the needs of students. The complexity of teaching means novices are on a journey toward being more effective. Ongoing research in teaching and related fields such as brain research means that experienced teachers are also on a journey toward being more effective. In other words, we are all on the continuum somewhere and trying to move in the “right” direction. As a coach, you support teachers in self-assessing where their strengths lie and where they might want to shift their practices.

Figure 1.4

Shifts in Classroom Practice

Shift 1: From *stating-a-standard* toward *communicating expectations for learning*

Teacher shares broad performance goals and/or those provided in standards or curriculum documents.



Teacher creates lesson-specific learning goals and communicates these goals at critical times within the lesson to ensure students understand the lesson's purpose and what is expected of them.

NCTM Teaching Practice: **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.

Shift 2: From *routine tasks* toward *reasoning tasks*

Teacher uses tasks involving recall of previously learned facts, rules, or definitions and provides students with specific strategies to follow.



Teacher uses tasks that lend themselves to multiple representations, strategies, or pathways encouraging student explanation (how) and justification (why/when) of solution strategies.

NCTM Teaching Practice: **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**.

Shift 3: From *teaching about representations* toward *teaching through representations*

Teacher shows students how to create a representation (e.g., a graph or picture).



Teacher uses lesson goals to determine whether to highlight particular representations or to have students select a representation; in both cases, teacher provides opportunities for students to compare different representations and how they connect to key mathematical concepts.

NCTM Teaching Practice: **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.

Shift 4: From *show-and-tell* toward *share-and-compare*

Teacher has students share their answers.



Teacher creates a dynamic forum where students share, listen, honor, and critique each other's ideas to clarify and deepen mathematical understandings and language; teacher strategically invites participation in ways that facilitate mathematical connections.

NCTM Teaching Practice: **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.

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Shift 5: From questions that seek expected answers toward questions that illuminate and deepen student understanding

Teacher poses closed and/or low-level questions, confirms correctness of responses, and provides little or no opportunity for students to explain their thinking.



Teacher poses questions that advance student thinking, deepen students' understanding, make the mathematics more visible, provide insights into student reasoning, and promote meaningful reflection.

NCTM Teaching Practice: **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.

Shift 6: From teaching so that students replicate procedures toward teaching so that students select efficient strategies

Teacher approaches facts and procedures with the goal of speed and accuracy.



Teacher provides time for students to engage with mathematical problems, developing flexibility by encouraging student selection and use of efficient strategies; teacher provides opportunities for students to evaluate when a strategy is best suited for the problem at hand.

NCTM Teaching Practice: **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.

Shift 7: From mathematics-made-easy toward mathematics-takes-time

Teacher presents mathematics in small chunks so that students reach solutions quickly.



Teacher questions, encourages, provides time, and explicitly states the value of grappling with mathematical tasks, making multiple attempts, and learning from mistakes.

NCTM Teaching Practice: **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.

Shift 8: From looking at correct answers toward looking for students' thinking

Teacher attends to whether an answer or procedure is (or is not) correct.



Teacher identifies specific strategies or representations that are important to notice; strategically uses observations, student responses to questions, and written work to determine what students understand; and uses these data to inform in-the-moment discourse and future lessons.

NCTM Teaching Practice: **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.

Source: NCTM Teaching Practice Statements from National Council of Teachers of Mathematics (NCTM). (2014). Principles to Actions: Ensuring Mathematical Success for All. Reston, VA: Author.

Importantly, the *Shifts in Classroom Practice* are represented on a continuum and must be understood this way, not as a dichotomy. In focusing on improving learning opportunities for students and moving to the right on any of the *Shifts*, we recognize teaching as a complex and intellectually stimulating endeavor as we seek to figure out what specific actions might move us along the continuum. The Teaching Practices and *Shifts in Classroom Practice* can also be synthesized into look fors related to teacher actions. In the Appendix, you will find the Teaching Practices & *Shifts in Classroom Practice* Look Fors Bookmark, providing an at-a-glance resource for **professional learning**.



You can also download the bookmark at resources.corwin.com/mathematiciscoaching.

Any one of these (interrelated) *Shifts*, or a combination of them, can be the focus of professional development, coaching conversations, and data gathering. The classroom practices described on the right side of the *Shifts*—whereby students are encouraged to understand, to reason, to hear, and to respond to ideas presented by their peers, and whereby the teacher challenges and supports their efforts to solve **high-level mathematical tasks**—are necessary in providing optimal learning opportunities for students to become mathematically proficient.

Connecting the *Shifts* to the Mathematical Practices

Imagine mapping the *Shifts* in Figure 1.4 to the Mathematical Practices in Figure 1.3 (or use the two Look Fors bookmarks). Identify one Mathematical Practice and see which *Shifts in Classroom Practice* you think would support student development of that Mathematical Practice. Did you identify one *Shift*? Three *Shifts*? Or did you see potential in each *Shift*? All of these responses could be considered correct. Work on any one *Shift* can affect student learning, as can work across the *Shifts*. Now imagine that you have done this same activity for all the Mathematical Practices. You will have a complex mapping of Mathematical Practices to *Shifts*. You can see that to develop mathematical proficiency for students, *all the Shifts in Classroom Practice* matter. And *any one* of the *Shifts in Classroom Practice* can contribute to student development of *any number* of the Mathematical Practices. In Chapter 12 of this book, we provide several professional development activities for engaging teachers in making these connections.

There are numerous ways to use the *Shifts* as tools to focus professional learning. You may decide to have your entire group of teachers from a particular setting (e.g., a course, grade, school, or entire district) select and focus on one *Shift* and have that be at the center of curriculum/lesson design, lesson study, or coaching cycles. Instead, or in addition, you may want to engage teachers in identifying their own *Shift* independently, selecting one that they feel will make the most difference in their own students' learning or one they feel is most needed to “move to the right.” Instead of selecting a *Shift*, you may wish to have teachers take on all the *Shifts*, assessing where they are (see **Self-Assessment** Tool 2.1) and moving forward across the *Shifts*. A hybrid of these ideas is to select a subset of the *Shifts* that is most closely connected to a particular focus (e.g., **formative assessment**) and to work on that subset of *Shifts* (see a self-assessment tool as the first tool in each of the Focus Zone chapters).

Focus Zones

The *Shifts* themselves are multifaceted and complex. It may not be clear how these comprehensive teaching practices address needs for students or challenges in a particular setting. This raises the following question:

How do we (as coaches and teacher leaders) help teachers make the Shifts in Classroom Practice that lead to mathematical proficiency?

When it comes to professional learning, it can be helpful to find a zone in which to work—one that addresses immediate needs of teachers and/or significant needs within a school or district setting. Generically, a *zone* is a separate area with a particular function, and that is exactly how we use the term here related to professional learning about mathematics teaching. A particular function might be to engage students or to analyze student work. Focusing on a zone provides an opportunity for pragmatic discussion, learning, and documenting of zone-specific strategies, ideas, and practices that can then be connected to the LMP Framework, with an eye constantly on developing mathematically proficient students.

There is certainly a myriad of possible **focus zones**. In this “everything-you-need book,” we could not include every possibility! We selected eight Focus Zones based on these criteria:

- Is commonly encountered by mathematics coaches (based on surveys and input from you, the mathematics coaches)
- Has a research basis connecting the Focus Zone to student learning
- Has the greatest potential to shift classroom practices to the right

Our selected Focus Zones are listed in Figure 1.5. Each of these Focus Zones is a chapter in this book. And in that chapter is a Coach’s Digest with resources for you and your teachers, as well as a Coach’s Toolkit, which is a set of seven to ten tools to support professional learning and coaching cycles specific to that Focus Zone.

Figure 1.5 **Focus Zones for Mathematics Professional Learning**

<i>Chapter</i>	<i>Focus Zone</i>
Chapter 3	Content Knowledge and Worthwhile Tasks
Chapter 4	Engaging Students
Chapter 5	Questioning and Discourse
Chapter 6	Formative Assessment
Chapter 7	Analyzing Student Work
Chapter 8	Differentiating Instruction for All Students
Chapter 9	Supporting Emergent Multilingual Students
Chapter 10	Supporting Students With Special Needs

Connecting Focus Zones to the LMP

Identification of a Focus Zone might occur in a variety of ways. As part of goal setting for the year, a group of teachers may select a focus (based on their self-assessment of the *Shifts in Classroom Practice*, for example). Or this could be part of a one-on-one coaching conversation—for example, with a beginning teacher. Together, you may agree that the focus of your work together will be on questioning and discourse. You both select this Zone because you see it as a way to work on *Shift 4* (from *show-and-tell* toward *share-and-compare*) or *Shift 6* (from *teaching so that students replicate procedures* toward *teaching so that students select efficient strategies*). In both cases, the *Shifts* were selected in order to develop one or more of the Mathematical Practices, such as Mathematical Practice 1 or both Mathematical Practices 1 and 3.

Enacting the Framework

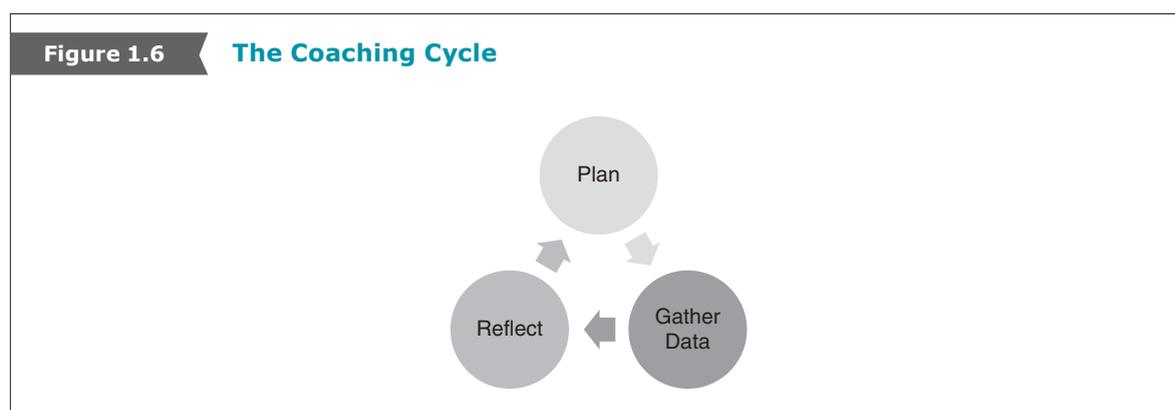
We have described the LMP Framework in the way it can be used in designing professional learning experiences, beginning with the goal of student outcomes. Once the design is in place, it is essential to revisit the connections in the Framework (see the arrows on the right side in Figure 1.1). The selected Focus Zones support the *Shifts in Classroom Practice*.

Seeing how changes in a specific Zone, such as content and worthwhile tasks, are impacting several *Shifts* honors the efforts of teachers. Most importantly, it is crucial for teachers to see how efforts in a Focus Zone and/or on a *Shift in Classroom Practice* increase students' opportunities to learn (OTL). For example, as teachers use questioning and discourse (Focus Zone 5) to shift toward “teaching so that students select efficient strategies” (*Shift 6*), they need to see the different ways that students are developing flexibility and **efficiency** and the related Mathematical Practices that are therefore now evident in their students. It is very powerful to see how a particular instructional move or new routine can make significant changes in students' opportunities to learn important mathematics!

As you work on these three components of the LMP Framework, you may be leading professional learning and/or participating in coaching cycles. Professional learning ideas are provided in Chapters 2 through 10. Chapter 12 is focused specifically on presenting professional development, and Chapter 13 is focused on facilitating professional learning. The coaching cycle can play a critical role in professional learning, so it is important to consider some basic ideas to ensure coaching cycles are effective.

Coaching Cycle

The **coaching cycle** is commonly presented as a three-phase process: *pre-observation*, *observation*, and *post-observation*. This cycle and the titles of each component originated from clinical supervision models (Glickman, Gordon, & Ross-Gordon, 2001; Goldhammer, 1969). When this clinical supervision model is used in educational settings, it is typically incorporated as part of an evaluation system. **Coaching**, however, is not about evaluation; it is about learning. Therefore, we believe that mathematics coaches should not be involved in formal teacher evaluation. So we will adapt the language of the coaching cycle to focus on the collaborative activity in which the coach and teacher engage during each phase of the cycle and use the terms *plan*, *gather data*, and *reflect* (see Figure 1.6).



The coaching cycle is dynamic and contextual. By *dynamic*, we mean that the cycle is flexible. You can begin at any phase of the coaching cycle. Of course, the ideal situation is that you have enough time in your day to conduct a complete coaching cycle with every teacher with whom you work! Obviously, that won't happen. But that doesn't mean that you then abandon the coaching cycle. Even if you do not have a planning conversation with a teacher or are not present during the lesson to collect any data, you can still have a reflecting conversation with the teacher that will support his or her growth. A teacher could ask you to come to her or his class and collect some specific data during a lesson. You could do this without previously having a planning conversation about the lesson. If you do not have the luxury of the time needed to complete the entire coaching cycle, engaging a teacher in any one part of the cycle is a valuable learning experience. By *contextual*, we mean that the implementation of the coaching cycle will be influenced by many factors, such as the teacher and coach's relationship, their beliefs about teaching and learning, and their educational experiences.

Phases of the Coaching Cycle

In this section, we briefly share the purpose of each phase, effective practice within each phase, and tips for using this book to support a coaching cycle.

Plan

Your goal during the planning phase of the coaching cycle is to support the teacher in effective lesson planning. This action may vary, depending on the teacher with whom you are working and the focus of the conversation. For example, you might be working with a beginning teacher who needs support in selecting goals and aligning lesson activities, or you might be working with a veteran teacher who is striving to engage all learners. Regardless of the specific situation, the coaching relationship should be collegial and reciprocal, one in which both the coach and the teacher are full participants, each learning from the discussion. Planning tools are in each of Chapters 2 through 10. Each tool provides "instructions to the coach" and general instructions as needed. The downloadable version of the tool does not include the "instructions to the coach," so it can be e-mailed to teachers or printed for them.

Gather Data

During this next phase of the coaching cycle, the coach is collecting data for the teacher. Thus, you and the teacher *together* decide what data will be gathered and what type of tool you will use for the data collection (see Coach's Toolkit in Chapters 2–10 for possibilities). The key to effective data collection is setting aside judgment and only collecting observable data (what you see and hear). For example, consider these two comments recorded on a data-gathering tool:

*"Teacher asks **open-ended** question."*

"Teacher asks students to explain how they solved Problem 4."

The first statement is a judgment about the type of question being asked. The latter statement is the actual data. Engaging the teacher in making judgments about the data collected can take place in the *Reflect* phase of the coaching cycle. You will notice that many of the data-gathering tools in the Coach's Toolkits provide significant space for recording data and then ways to later code that data *with* the teacher. The tools can be copied for teachers but are also available for download so you can type data on the tool.

Reflect

Planning and data gathering are important, but their potential impact is realized through reflecting on the lesson and data. When we take the time to process our experiences, we gain insights that are

essential to our professional growth. It is during the *Reflect* phase that any data gathered for the teacher is shared for discussion and analysis. It is also possible to have a reflecting conversation without any data to analyze. In either case, the questions you ask will support the teacher in reflecting on the lesson in critical ways. As with planning and data gathering, Chapters 2 through 10 provide options for reflecting.

Having tools to support each phase of the coaching cycle can help keep the focus on its intended goal. However, while we have placed tools under the headers of *Self-Assess*, *Plan*, *Gather Data*, and *Reflect*, many of the tools can be used in other phases. In the many stories we have heard from coaches, we often hear of only a single tool being used across the coaching cycle—for example, the coach uses the self-assessment tool but gathers evidence on sticky notes. These tools are meant to be a menu—select any that make sense for your setting/context.

Navigating the Coaching Cycle

Of course, simply understanding and having tools for the coaching cycle is not enough! In Chapter 11, we describe coaching skills that are critical for all coaching interactions, such as building trust and rapport, listening, paraphrasing, and posing questions. For each skill, we present a synopsis that includes a description of the skill, tips for effectively implementing the skill, insights from the field, and additional resources for further study. We recognize that these skills are complex, and becoming proficient in them is an ongoing process that develops over time. The briefs provided in Chapter 11 are intended to be a *Reader's Digest* version—at-a-glance support, reinforcement, and links to other resources that can support your work as a mathematics coach.

Getting Started

As you engage in coaching, we hope the LMP Framework provides a road map for you and your teachers. The Framework components place the purpose for change on goals for students (Mathematical Practices) via *Shifts in Classroom Practice* that can occur when professional development efforts focus on particular Focus Zones. As a coach, you can help teachers make strategic decisions on where to focus, as well as make explicit the connections between the components of the Framework (see Figure 1.2 and Tool 2.3). Your collaborative decision-making supports and is supported by the coaching cycle, as well as other professional learning opportunities.

Chapter 2 begins with an overview of the components of the LMP Framework already described, but it has been written for a teacher or administrator audience. This can be used to begin the conversation with teachers about setting goals related to mathematics learning and teaching. In your busy, multifaceted efforts to support teachers and their students, we truly hope that this book provides *almost* everything you need—at least as a starting place—because we recognize that your efforts as a mathematics coach are critical to improving mathematical learning opportunities for all students.