CHAPTER 1

Using High-Performing Collaborative Teams for Mathematics

Far too frequently, your mathematics professional development experience as a grades 3–5 elementary school teacher likely feels inadequate. Why? It could be because you receive little or no professional development time dedicated to teaching, learning, and assessing mathematics. Unless you are in the process of implementing a new mathematics curriculum, which may happen every six to eight years, the focus of most professional development time is in another major area of need—literacy.

To be certain, professional development in literacy for grades 3–5 is essential. After all, the evidence is clear that students who struggle to read in your class often struggle in mathematics as well. Skill in reading is necessary for success in mathematics (Gersten, Jordan, & Flojo, 2005; Jordan & Hanich, 2003). However, in order for you to transition to the Common Core State Standards for mathematics, you will need to shift the same amount of priority time to your professional development in mathematics (National Governors Association [NGA] Center for Best Practices & Council of Chief State School Officers [CCSSO], 2010).

Think about your most recent professional development experience in mathematics. What was it like? Was it a collection of short and disjointed *make- and take-it* workshops or *try-this* games? Or was it a robust and collaborative professional development experience that focused on tasks designed to improve the quality of instruction, connect to important mathematics, and advance student learning?

The expectations of the CCSS content standards and the CCSS Mathematical Practices (NGA & CCSSO, 2010), as well as the research on highly effective mathematics instruction, will require a new professional development learning emphasis on mathematics instruction for you and your colleagues who teach in grades 3–5. This will require using professional development resources—and, most significantly your, *time*—to learn the content and pedagogical shifts needed to teach for the depth and conceptual understanding expectations outlined in the CCSS for mathematics. You should not do so alone. This opening chapter examines the first of the second-order paradigm shifts necessary for successfully implementing the CCSS mathematics standards—the need for you to work within grade-level collaborative learning teams to expand your knowledge capacity and bring coherence to your interpretation and implementation of the CCSS. This opening chapter examines the role and activities of collaborative teams in making the necessary accommodations in professional development to ensure successful implementation of these new mathematics content standards and practices. Working together with your colleagues, you will be able to expand your knowledge and bring mutual understanding to CCSS implementation. Together, you will develop a common vocabulary that helps you to communicate more effectively about changes in your instructional practices. (See the introduction, pages 2–3, for descriptions of the five paradigm shifts.)

Effective Mathematics Professional Development

There is new clarity as to what constitutes effective professional development. Linda Darling-Hammond (2010) provides one of the best summaries of the research on effective professional development for teachers:

> Effective professional development is sustained, ongoing, content-focused, and embedded in professional learning communities where teachers work over time on problems of practice with other teachers in their subject area or school. Furthermore, it focuses on concrete tasks of teaching, assessment, observation, and reflection, looking at how students learn specific content in particular contexts. . . . It is often useful for teachers to be put in the position of studying the very material that they intend to teach to their own students. (pp. 226–227)

In other words, effective mathematics professional development is sustained and embedded within professional learning communities and focused on the actual tasks of teaching using the same materials you use with students. What is meant by *sustained?* It means *effective professional development*—programs that have demonstrated positive and significant effects on student achievement (gains of more than 20 percentile points) and somewhere between thirty and one hundred hours of contact time with teachers over the course of six to twelve months (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Garet et al., 2010).

We know with certainty that the most effective professional development immerses you in collaboratively studying the curriculum you will teach in a structured way with other teachers, as well as in assessing how your students will acquire that curriculum. This kind of professional learning is embedded in your instructional practice. At the lesson level, this approach ultimately leads to your deeper understanding and thus wider adoption of the curricular and instructional innovations sought (Penuel, Fishman, Yamaguchi, & Gallagher, 2007; Wayne, Kwang, Zhu, Cronen, & Garet, 2008). The capacity to provide this type of sustained and focused collaborative professional development for you as an elementary school teacher must be the vision for future professional development if mathematics instruction is to significantly improve and the vision of the CCSS for mathematics is to become a reality.

Professional learning communities have become ubiquitous in education, and you may equate PLCs with teacher collaboration. At the same time, various definitions and understandings regarding a PLC *culture* abound. In this book, we use the work of DuFour, DuFour, and Eaker's (2008) *Revisiting Professional Learning Communities at Work* and DuFour, DuFour, Eaker, and Many's (2010) *Learning by Doing* to define the conditions for collaborative mathematics learning teams in an authentic PLC school culture. For the purposes of this book, we will refer to grade-level groups of teachers working together in a PLC as *collaborative teams*.

Professional Development Paradigm Shift

An often-troubling problem with mathematics instruction and assessment is that they are too inconsistent from classroom to classroom, school to school, and district to district (Morris & Hiebert, 2011). Is this the case at your school? Would you be comfortable if your own child were assigned any fourth-grade teacher in your building?

How much mathematics a fourth grader in the United States learns, and how deeply he or she learns it, in many schools is largely determined by the student's school and, even more directly, the teacher the student is assigned to. Sometimes, the inconsistencies teachers develop in their isolated practice can create gaps in curriculum content with consequent inequities in students' instructional experiences and learning (Kanold, 2006). Noting that isolation is the enemy of improvement, Eaker (2002) observes, "The traditional school often functions as a collection of independent contractors united by a common parking lot" (as cited in Schmoker, 2006, p. 23).

Your students come to school with many challenges, and you are expected to ensure each student receives, understands, and masters the more rigorous content standards outlined in the CCSS. One of the characteristics of high-performing elementary schools successfully closing the achievement gap is their focus on teacher collaboration as a key to improving instruction and reaching all students (Education Trust, 2005; Kersaint, 2007). Only through a collaborative culture are you provided both the instructional knowledge and skills required to meet this challenge, as well as the energy and *support* necessary to reach all students (Leithwood & Seashore Louis, 1998). Seeley (2009) characterizes this challenge by noting that "alone we can accomplish great things . . . but together, with creativity, wisdom, energy, and, most of all commitment, there is no end to what we might do" (pp. 225–226).

Collaborative learning teams provide you the supportive environment necessary to share your creativity and wisdom and to harness the energy and persistence necessary to meet the demands of students' needs and the challenges of the CCSS.

Adequate Time for Collaborative Teams

Thus, mathematics professional development at the elementary school level must help you to work in a grade-level collaborative team within a PLC school culture. The best hope for you and your students to be successful in mathematics in the era of the Common Core State Standards for mathematics *requires* this shift. The effectiveness of your collaborative teams will depend on how well the standards are implemented. Effective implementation begins with the provision of adequate time for you to collaborate. The research indicates that significant achievement gains are only achieved when teacher teams are provided with sufficient and consistent time to collaborate (Saunders, Goldenberg, & Gallimore, 2009).

The world's highest-performing countries in mathematics or sustained educational improvers—Singapore, Hong Kong SAR, South Korea, Chinese Taipei, and Japan—allow significant time for elementary school mathematics teachers to collaborate and learn from one another (Barber & Mourshed, 2007; Stigler & Hiebert, 1999). This requires that school districts shift their priorities to support weekly collaborative professional development opportunities in the form of grade-level teacher collaboration time (Hiebert & Stigler, 2004). Teaching the grades 3–5 Common Core State Standards for mathematics is a much more complex endeavor than generally perceived if done with fidelity, and collaborative teams with regular time to meet will be necessary for successful implementation of the CCSS.

How much time? You should have a dedicated block of grade-level collaborative team time once a week, and each session should be at least sixty minutes long. This time needs to be embedded within your professional workday; that is, ideally, it should not be scheduled in the stereotypical arrangement of *every Tuesday after school, once a week* (Buffum, Mattos, & Weber, 2009). When such "professional development" is scheduled beyond the normal workday, after you have spent the entire day working with students, there are two problems. First, it sends the message to you and parents that your professional learning is not that important; if it were, it wouldn't be an add-on to a full day. Second, as you know, teaching is hard work, and teachers are tired at the end of the day. The type of collaborative work that needs to take place in grade-level collaborative teams requires you to be fresh and focused on the task at hand. Collaborative professional development work simply cannot be done as effectively in an after-school session at the end of a long day of hard work.

Some school systems that are implementing the PLC process have early-release or late-start days. There are objections to late-start or early-release schedules, particularly at the elementary level, when students cannot provide their own transportation, and there are concerns about the loss of instructional time. In addition, financial constraints may make it difficult for schools to implement late-start or early-release schedules. However, schools committed to teachers working collaboratively in learning teams have found a number of ways to find collaboration time that do not require money or result in a loss of instructional time (DuFour et al., 2010). Consider the following. (See www.allthingsplc.info for additional collaborative time scheduling ideas.)

- **Parallel scheduling:** Grade-level teachers in grades 3–5 can have a common preparation time by assigning specialists (music, art, physical education, and so on) to work with students across the entire grade at the same time. The grade-level team then can designate one day each week for collaborative planning rather than individual planning.
- **Shared classes:** Students across two different grade levels can be combined into one class while the other team engages in collaborative work once a week.

- **Extended faculty meeting time:** Time can be scheduled for teams to work together during faculty meeting time, changing the focus of faculty meetings from administrative communication to professional learning for teachers.

As an elementary teacher, you face another unique time challenge: how should you split collaborative team time equitably between literacy and mathematics? Note that the assumption is that you will work within your collaborative team to address both mathematics and literacy instruction for student learning. This is not an either/or choice but rather a matter of how you can most effectively do both. Literacy and mathematics both have new Common Core State Standards, both face new consortia assessments, both remain factors in a school's accountability calculation, and therefore both subjects must be addressed within collaborative teams.

Lezotte (1991) argues that one of the characteristics of the most effective schools is their willingness to declare that some subjects are more important than others and to assign more instructional time to those that are considered most important. It is time that administrators and faculty in elementary schools finally heed this advice and prioritize student instructional time, intervention time, and your professional learning time accordingly in favor of literacy *and* mathematics. In many school systems, because literacy typically dominates professional development time, this will require an increase in both the instructional focus and professional development work devoted to mathematics instruction.

There are three possible models we suggest you follow when allocating your collaborative team time to literacy and mathematics. These include:

1. Implementing an alternating schedule, designating every other week for mathematics or literacy
2. Spending two consecutive weeks a month on mathematics and two consecutive weeks on literacy
3. Spending half the time during each collaborative team session on literacy and half on mathematics

Regardless of the model you select, note that the third model—splitting each session between literacy and mathematics—is not recommended in the first year of implementation, unless you have a significant amount of collaboration time each week. The type of work outlined here requires significant and focused work, which cannot be effectively done in a once-weekly thirty-minute session. In the first year of implementation, you may consider devoting one semester of collaborative team time to mathematics and the other to language arts to allow sufficient time to focus on and experience the benefits of all the steps in the collaborative team process in one content area before tackling another.

The challenge of developing the content knowledge and content-specific pedagogical knowledge necessary to become a highly effective teacher of reading, language arts, and mathematics, particularly in the upper intermediate grades, is daunting. This has led some school districts to adopt a model in which individual teachers in the upper intermediate grades specialize in either literacy or mathematics instruction. Compelling arguments have been made in support of this organizational approach for mathematics instruction (Reys & Fennell, 2003). Although some research indicates that this model can have a positive effect on student achievement and that these achievement gains are cumulative across two to three years (Campbell, 2011), the research on the overall effectiveness of this approach is not substantial (National Mathematics Advisory Panel [NMAP], 2008). It may be that the most critical factor is your selection and implementation of effective instructional strategies, not the nature of your assignment. It is also worth noting that content specialization can isolate teachers and does not promote a collaborative school culture.

Therefore, particularly after year one of implementation, the most effective model to consider is the first—alternating weekly focus between literacy and mathematics instruction. As described later in this chapter and more fully in chapters 4 and 5, much of your work in collaborative teams is focused on responding to your students' performance on collaboratively developed assessments. Waiting two weeks to discuss students' performance on assessments and planning appropriate instructional responses in mathematics lets too much time pass between collaborative sessions and defeats the timely intervention response of collaborative teams.

Grade-Level Collaborative Mathematics Teams

Your collaborative work focuses on reaching agreement on the answers to the four critical PLC questions for student learning (DuFour et al., 2008):

1. What mathematics (content and practices) should students learn? (See chapters 2 and 3.)
2. How should we develop and use the common and coherent assessments to determine if students have learned the agreed-on curriculum? (See chapter 4.)
3. How should we respond when students don't learn the agreed-on curriculum? (See chapter 5.)
4. How should we respond when students do learn the agreed-on curriculum? (See chapter 5.)

It might seem that the CCSS have answered once and for all what students should learn and how they should engage in mathematics as they develop competence within the content domains and through the Mathematical Practices. To some degree, this is true, but there are still significant issues that you need to discuss in your grade-level collaborative team and reach agreement with respect to what students should learn and when they should learn it. While the CCSS at the elementary level (K–5) outline a clearly defined and coherent set of grade-level standards within the mathematics domains, all teachers at each grade level in your school should have a deep across-grades understanding, a deep grade-level understanding, and a deep understanding of the shifts in emphasis recommended in the CCSS. Knowing how to read the CCSS grade-level standards is an important first step in developing a common vocabulary within the collaborative team. Figure 1.1 defines the key terms used in the CCSS and identifies the domains that are presented in grades 3–5.

Standards define what students should understand and be able to do.

Clusters summarize groups of related standards. Note that standards from different clusters may sometimes be closely related because mathematics is a connected subject.

Domains are larger groups of related standards. Standards from different domains may sometimes be closely related. The domains for grades 3–5 are Operations and Algebraic Thinking, Number and Operations in Base Ten, Number and Operations—Fractions, Measurement and Data, and Geometry.

Domain

Number and Operations in Base Ten 3.NBT

Use place-value understanding and properties of operations to perform multidigit arithmetic.

1. Use place-value understanding to round whole numbers to the nearest 10 or 100.
2. Fluently add and subtract within 1,000 using strategies and algorithms based on place value, properties of operations, or the relationship between addition and subtraction.
3. Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (for example, 9 × 80, 5 × 60) using strategies based on place value and properties of operations.

Standard

Cluster

Source: Adapted from NGA & CCSSO, 2010, p. 5.

Figure 1.1: How to read the grade-level standards.

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The focused nature of the CCSS, and the careful attention paid to students' developmental learning progressions, means that some of the topics you traditionally taught in certain grades have been moved to other grades, and some topics have simply been eliminated from the elementary school curriculum. For example, the CCSS emphasize fractions beginning at the third-grade level and delay probability until the middle grades. Traditionally, both of these topics were introduced in the primary grades and remained topics in each elementary school grade. The purpose of this more focused curriculum is to provide you more time to teach fewer critical topics in greater depth.

You need to spend time in your collaborative team reviewing and reaching agreement on the grade-level scope and sequence you will use to ensure the alignment of the mathematics content with your district's expectations as well as the CCSS. You should also spend some collaborative team time in vertical discussions. For example, if you are a fourth-grade teacher, you should meet with the third- and fifth-grade teachers to ensure appropriate articulation across grade levels.

One of the primary purposes for taking time to discuss the CCSS content standards in grade-level collaborative teams is to develop *shared teacher ownership* of the CCSS content standards and Mathematical Practices. This means discussing each domain and standard cluster as a team to develop a common understanding of what each standard means and what student understanding and proficiency with each standard looks like. For example, in third grade, one of the CCSS content standards for the domain Number and Operations—Fractions states that students will "Understand a fraction $1/b$ as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size $1/b$" (NGA & CCSSO, 2010, p. 24). Simply reading this standard might be a language issue, as you or your teammates may not have typically used this exact phrasing of the standard. It is crucial that every third-grade teacher understands what the standard means, what mathematics content he or she should expect students to learn about the standard, and what it will look like when students have learned it. It is one thing to be handed a set of written standards—even if the standards are clear, concise, coherent, focused, and individually understood. It is quite another to ensure that everyone on your team has a shared understanding of what those standards mean and what student demonstrations of that understanding, fluency, or proficiency look like.

It is most important that your collaborative team spends significant time discussing the CCSS critical areas for instructional emphasis at your grade level. It should be noted that these critical areas are directly connected to the *Curriculum Focal Points* (NCTM, 2006), so they may present a common ground for discussing grade-level priorities and focus. Consider the following three critical areas for instructional emphasis in grade 4:

1. Developing understanding and fluency with multi-digit multiplication, and developing understanding of dividing to find quotients involving multi-digit dividends.
2. Developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers.
3. Understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry. (NGA & CCSSO, 2010, p. 27)

Your collaborative team needs to ensure that the mathematics content you teach students, as reflected in your pacing documents, lessons, assessments, judicious review activities, and intervention time, are all consistent with the CCSS emphasis on these three critical areas. The *Teaching With Curriculum Focal Points* (NCTM, 2008–2011) series and *Developing Essential Understanding* (NCTM, 2010–2012) series are excellent resources to support you as you work with your colleagues to develop highly effective lessons aligned with the identified critical areas of CCSS.

Resources for Developing Highly Effective Lessons

Developing Essential Understanding **(NCTM, 2010–2012):** This sixteen-book series addresses topics in preK–12 mathematics that are often difficult to teach but critical to student development. Each book gives an overview of the topics, highlights the differences between what students and teachers need to know, examines the big idea and related essential understandings, reconsiders the ideas presented in light of connections with other ideas, and includes questions for reflection.

Teaching With Curriculum Focal Points **(NCTM, 2008–2011):** This series supplements the *Curriculum Focal Points* with detailed guidance on instructional progressions, ways to introduce topics, and suggestions to build deeper understanding of essential topics. It includes grade-level volumes for preK–8 and grade-band volumes for preK–2, 3–5, and 6–8.

Considering the unprecedented clarity of the CCSS for mathematics, DuFour et al. (2010) verify why it is essential to take *action* in your collaborative team to develop a shared understanding of the content to be taught, because doing so:

- Promotes clarity among your colleagues
- Ensures consistent curricular priorities among teachers
- Is critical to the development of common pacing required for effective common assessments
- Ensures that the curriculum is viable—that it can be taught in the allotted time
- Creates ownership among all teachers required to teach the intended curriculum

Change in Instructional Emphasis

The Common Core State Standards for mathematics call for a different, and in some cases radically different, way of approaching the content as embodied in the Mathematical Practices. This significant change in instructional emphasis implies an increased need for pedagogical decision making and consistency as you work with your colleagues in your collaborative team to create equitable environments for students in which you use the Mathematical Practices as a vehicle to promote student learning with understanding.

A 2011 review of the Common Core State Standards for mathematics found that the standards represent an instructional shift toward higher levels of cognitive demand than traditionally represented in many state standards (Porter, McMaken, Hwang, & Yang, 2011). The cognitive demand of mathematical tasks matters. Higher student achievement is associated with more challenging mathematical tasks (Schmidt, Cogan, Houang, & McKnight, 2011). Traditional mathematics instruction is often characterized by low-level cognitive-demand tasks that do not support students in developing a deep understanding of mathematics (Silver, 2010). Consequently, it will be critical for you to work within your collaborative team to carefully design your mathematics instruction to engage students with the Mathematical Practices. This will be critical during initial planning, and especially after analyzing student learning, in order to increase the cognitive demand and effectiveness of the selected instructional tasks. *How* the mathematics content is approached to engage students in doing mathematics, as articulated in the Mathematical Practices, is as important—if not more important—than *what* is taught (Schmoker, 2011). Teachers working within grade-level collaborative teams are uniquely positioned to support one another in meeting the challenges associated with implementing the CCSS Mathematical Practices.

Mathematics education in the United States has a long history of confidence in standards and curriculum programs as the primary means to improve student achievement (Larson, 2009). But reliance on standards and materials alone to improve student achievement has not resulted in dramatic improvements in student learning over time. If implementation of the CCSS is to be more than merely superficial (little more than a content-standards mapping), and instead is to result in real improvements in student learning, then implementation efforts need to be more about *how* you approach the Mathematical Practices and not solely the curriculum or content standards.

Ultimately, how you teach the curriculum has a greater influence on student learning than the curriculum itself (Stein & Kaufman, 2010). As Wiliam (2011) contends, "Pedagogy trumps curriculum. Or more precisely, pedagogy *is* curriculum, because what matters is how things are taught, rather than what is taught" (p. 13). As school districts work to interpret and implement the CCSS, there will be a rush to adopt new textbooks, supplemental materials, intervention programs, and online materials as *the* solution to the transition and implementation challenges of the CCSS. Textbook publishers will be poised to offer their latest digital or text-based solutions. However, no matter what publishers promise, innovative materials alone will not—nor will they ever—improve mathematics instruction (Cohen & Ball, 2001). Student achievement is not solely a function of the agreed-on curriculum and the adopted commercial program.

Student achievement is more highly correlated with the nature of classroom instruction—how mathematics is taught rather than what program or materials are used (Slavin & Lake, 2008). An instructional approach that emphasizes high-cognitive-demand tasks that provide opportunities to reason, justify, analyze, and model mathematics—which are expectations in the CCSS Mathematical Practices and NCTM's Process Standards (NCTM, 2000)—is associated with higher student achievement (Stein & Smith, 2010). The CCSS Standards for Mathematical Practice are (NGA & CCSSO, 2010):

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. (pp. 6–8)

For the full descriptions of the Standards for Mathematical Practice, refer to appendix A (page 159).

Figure 1.2 outlines some high-leverage processes linked to the CCSS Mathematical Practices (Franke, Kazemi, & Battey, 2007; Hiebert & Grouws, 2007; Leinwand, 2009; NCTM, 2007; Stein, Remillard, & Smith, 2007; Stein & Smith, 2010; Teacher Education Initiative Curriculum Group, 2008; Weiss, Heck, & Shimkus, 2004).

- An instructional emphasis that approaches mathematics learning as problem solving (Mathematical Practice 1)
- An instructional emphasis on cognitively demanding conceptual tasks that encourage all students to remain engaged in the task without watering down the expectation level (maintaining cognitive demand) (Mathematical Practice 1)
- Instruction that places the highest value on student understanding (Mathematical Practices 1 and 2)
- Instruction that emphasizes the discussion of alternative strategies (Mathematical Practice 3)
- Instruction that includes extensive mathematics discussion (math talk) generated through effective teacher questioning (Mathematical Practices 2, 3, 6, 7, and 8)
- Teacher and student explanations to support strategies and conjectures (Mathematical Practices 2 and 3)
- The use of multiple representations (Mathematical Practices 4 and 5)

Figure 1.2: High-leverage mathematics instructional practices linked to CCSS Mathematical Practices.

Visit **go.solution-tree.com/commoncore** for a reproducible version of this figure.

The implementation of new standards—in this instance, the CCSS content standards—cannot once again be used as a distraction from a needed laser-like focus on *instruction* (that is, instruction that results in developing students who are proficient with the Standards for Mathematical Practice) if the goal is improved student learning (Noguera, 2004; Schmoker, 2006, 2011). Traditionally, mathematics educators have focused on standards and curriculum because they are easier to address than instruction. Make no mistake, standards, curriculum, textbooks, and related instructional materials are crucial tools for teaching and learning, but to truly improve student learning, the quality of mathematics instruction must improve, and that quality must become consistent across all grade levels.

To effectively implement the CCSS Mathematical Practices, you will need to acquire knowledge and ways of reasoning that enable you to analyze and make sense of your teaching, curricula, and students' mathematical thinking in new or more intense ways than you likely have previously done. In order to adopt the high-leverage instructional practices outlined in figure 1.2 (page 15), you also have to align your beliefs with this vision for instruction and decide that the change in your practice is worth the effort (Gresalfi & Cobb, 2011). Collaborative teams are perfectly structured to support you as you work to analyze and make sense of your teaching, come to identify with this new vision of teaching, determine that the change is worthwhile, and find the support necessary to change. This is only possible if the *how* of mathematics instruction—how students do mathematics, embodied in part by the Standards for Mathematical Practice—becomes a significant focus of the collaborative work accomplished in your collaborative team.

Research indicates that effective instruction rests in part on careful planning and that you should consider investing more of your work time in intentionally and systematically planning mathematics lessons with your grade-level colleagues (Morris, Hiebert, & Spitzer, 2009). One of the most effective strategies within collaborative teams to support your adoption of the high-leverage instructional practices (figure 1.2, page 15) is the use of a modified form of Japanese lesson study. Japanese lesson study is a highly structured process for designing and improving mathematics lessons (Fernandez & Yoshida, 2004) first introduced on a wide scale in the United States by Stigler and Hiebert (1999). Teachers collaboratively examine *problems of practice* and design lessons to address those problems (Little & Horn, 2007). Describing the process of formal lesson study in detail is beyond the scope of this book, but using some of the concepts of lesson study within your collaborative team is an effective way for you and your colleagues to begin to analyze how you will teach critical grade-level topics. Consider the following scenario, which describes a fifth-grade collaborative team engaged in much of the work this book recommends you undertake in your collaborative team as you work to implement the CCSS.

A collaborative team of fifth-grade teachers is meeting during its common plan time. The teachers know from work they have previously conducted this year that one of the CCSS fifth-grade critical areas for instructional emphasis is developing fluency with adding and subtracting fractions. The team also knows, based on its review of last year's assessment results, that this is an area in which students have traditionally struggled to demonstrate fluency. Even more concerning to the team is its belief that students don't understand the underlying concepts but rather rely on rote procedures, and this lack of understanding contributes to students' lack of fluency. The team recognizes that in order to develop deeper student understanding of adding and subtracting fractions, teachers need to improve the lessons they use to teach this concept, and this means they too need to develop a deeper understanding of the concepts.

So, the team members begin by discussing some reading they have done outside of their learning team on the topic using the book *Developing Essential Understanding of Rational Numbers for Teaching Mathematics in Grades 3–5* (Barnett-Clarke, Fisher, Marks, & Ross, 2010) and the report "Developing Effective Fractions Instruction for Kindergarten Through 8th Grade: A Practice Guide" (Siegler et al., 2010). This background reading has deepened the teachers' understanding of fractions and sparks a productive discussion of new instructional tasks, representations, and questions they can use with students to engage them in the concept and to check to make sure students understand the concept as the lesson unfolds. By the time the collaborative team is done, team members have written detailed lesson plans to introduce these concepts, which include detailed lesson notes, tasks and examples, key questions, anticipated student responses and their planned responses, guided practice tasks, summary questions, adaptations for English learners (ELs) or students with disabilities, and formative assessment strategies to determine if students have accomplished the instructional objective.

Each member of the team commits to using the lesson with his or her students, and the team has agreed to watch a video together of one team member teaching the lesson in order to evaluate the lesson's effectiveness. The team plans to focus its next collaborative team session on discussing the effectiveness of the designed lesson based on student performance, so teachers can both plan necessary responses to student learning and make modifications to the lesson so that they can further improve on the lesson prior to teaching it next year.

Intensive lesson planning as described in the preceding example is not only a high-leverage strategy to support you as you work to change your practice but is also an effective strategy to prevent the degradation of collaborative team discussions into mere story and material swapping or activity sharing (Perry & Lewis, 2010; Stein, Russell, & Smith, 2011). This type of intense collaborative lesson planning is time consuming and difficult to do for each lesson that is taught annually; unfortunately, you do not have that kind of planning time. However, the lack of time to devote to carefully planning and reflecting on all lessons cannot be used as an excuse to *never* collaboratively learn, plan, and reflect on the effectiveness of certain key lessons per standard cluster. Your goal must be to collaboratively design and refine more and more lessons over time. Effective planning is so important that Wiliam (2011) believes that "sometimes a teacher does her best teaching before the students arrive in the classroom" (p. 49). In order to begin the process of improving instruction, your collaborative team should determine the two to three most critical lessons that will be your focus in each unit and commit yourselves to collaboratively planning these key lessons, designing necessary interventions based on student learning, and revising these critical lessons for future use. Which lessons should be selected? The lessons selected for intensive planning and reflection should be focused on those standards students have struggled with most in the past, based on your analysis of prior student assessment results, and the CCSS critical areas for instructional emphasis.

Gradually, year after year, your collaborative team creates and revises more and more highly effective lessons, thereby continuously improving your instruction in small manageable chunks with shared energies rather than in isolation. Simultaneously, as your collaborative team works on lessons—hopefully side by side with other grade-level teams—and uses the refined lessons, you reduce the variation in instructional quality among teachers in your school by following a process that is similar to how other professions in the United States continually improve and develop consistency

(Morris & Hiebert, 2011). This process involves collaborative sharing of the same problem for which a product offers a solution, making adjustments to improve the product, and continuously improving the product with contributions from everyone in the system. This collegial approach is comparable to that of the PLC process as well as lesson study.

Over the course of a decade, a team of fifth-grade teachers might amass nearly one hundred highly effective lessons, in addition to more effective interventions for students who struggle and challenges for gifted students. The potential cumulative impact of this work on instructional effectiveness and student learning would be truly remarkable. Now imagine each collaborative teacher team within your school district carrying out this process. The powerful cumulative effect of students receiving more and more effective instruction, which can only be accomplished through this system of continuous improvement, has the potential to substantially eliminate the differences in student achievement due to inconsistencies in the quality of instruction and differences in socioeconomic status (Rivkin, Hanushek, & Kain, 2005).

Assessing What Students Should Learn

Once your collaborative team has agreed on the content you intend to teach students and the Mathematical Practices you intend to develop, you must next collaboratively create assessments and scoring rubrics that will indicate whether or not your students have learned the agreed-on content standards. The National Mathematics Advisory Panel recommends using weekly formative assessments with elementary students as a key strategy to support struggling students, provided the assessment results are used to adapt instruction based on student progress (NMAP, 2008).

This recommendation is based on a wealth of research on effective instructional interventions in mathematics; research on the power of formative assessment to impact student achievement; and research on the practices that are in place at schools that are successfully raising the achievement of all students while simultaneously closing the achievement gap (Baker, Gersten, & Lee, 2002; Hanley, 2005; McCall, Hauser, Cronin, Kingsbury, & Houser, 2006; Popham, 2008; Wiliam, 2007b, 2011; Wiliam & Thompson, 2007; Williams, 2003). Researchers have found that the use of formative assessment processes (described fully in chapter 4) as a component of mathematics instruction is one of the most effective educational interventions (Black & Wiliam, 1998).

It is important to recognize that every assessment used in grades 3–5 can and should serve a formative function because the results can be used to provide students with targeted additional support. But before your collaborative team can modify instruction and provide students with targeted additional support, it is necessary to clearly identify the specific mathematics weaknesses and strengths of individual students (Hanley, 2005). Chapter 4 discusses the use of summative assessment instruments as formative tools. Chapter 5 provides in-depth guidance on structuring intervention. The focus now is to explain why it is important for you to spend time collaboratively developing assessments and scoring rubrics within your collaborative team.

When you meet in your collaborative team to discuss and plan a phase of instruction, you need to begin your planning with the end in mind (Wiggins & McTighe, 2000). Once your collaborative team has identified what you want your students to learn, and before you begin to collaboratively plan the first lesson of a *unit* (a period of instructional time, not content), it is crucial your team works together to build the common formative and summative assessments you will use during that unit.

During that time, your team will determine if your students are making progress learning the agreed-on curriculum (by using formative assessment for regularly monitoring and improving understanding) and acquiring the agreed-on curriculum at the end of the instructional unit (by using summative assessment to provide an indication of understanding, proficiency, fluency, and problem-solving skill).

It is essential that these assessments be collaboratively created *and* that each member of the collaborative team agrees to use these assessments and scoring rubrics. During the process of creating these common classroom assessments and scoring rubrics, each member of your collaborative team clearly defines and solidifies his or her own expectations for student performance and, more important, each team member develops a shared expectation for student performance, how it will be measured, and how it will be recorded—removing one of the instructional inconsistencies that plagues teaching and learning.

Consider an example. One of the critical areas for instructional emphasis in the grade 3 CCSS is that students will develop an "understanding of multiplication and division and strategies for multiplication and division within 100" (NGA & CCSSO, 2010, p. 21). Unless you work together as a team to develop and use common assessments, one teacher may plan to administer a series of timed procedural multiplication and division basic fact tests, while another teacher may require students to write a series of related facts and explain how the different equations are related, emphasizing the conceptual relationship between multiplication and division. The qualitative difference in depth of knowledge expectations between these two approaches is significant and has a tremendous impact (from an equity perspective) on what students will learn.

If your team collaboratively writes the assessments and scoring rubrics with agreed-on depth of knowledge expectations, then each member of the team shares an understanding of what is expected of students and, more important, *the same performance level is expected of all third-grade students* no matter which teacher the students are assigned. Equally important—by starting with the development of the assessments—all members of your team from the beginning know how students will be assessed. This in turn affects how you will teach. The assessment must focus on conceptual understanding, as CCSS require, and each teacher must know this in advance of teaching the lessons. The collaborative team commitment to using the common assessments and scoring rubrics in turn demands that daily mathematics instruction must also focus on conceptual understanding.

Student performance on these common assessments will be shared with everyone in the collaborative team in order to plan appropriate and targeted intervention. The common unit assessments provide a powerful incentive to make sure that the same content is taught and the same high level of student performance is expected of all students—procedural *and* conceptual learning goals. In this sense, assessment not only informs instruction but actually directs instruction.

The type of formal formative assessment suggested here is to be relatively short in duration—ten minutes, at most, and only covering material taught in the previous two to three lessons—and its use does not result in a significant loss of instructional time. This use of formative assessment as an instructional tool should not be distinguished from the act of effective instruction; in fact, the evidence suggests that the use of formative assessment actually leads to increased precision in how instructional time is used (NMAP, 2008). It is important to keep in mind that formative assessment is a continuous process and not characterized by the use of any specific pencil-and-paper assessment instrument (see chapter 4 for details).

Response to Intervention

An assessment is only formative if you use the results to inform and improve your instruction; effective assessment requires you to take action (respond) when it is determined that students have not learned some component of the agreed-on curriculum. The response also has to be directive; all students who need additional support must be provided the additional support they need (Buffum et al., 2009). DuFour et al. (2008) outline four practices that a school must do to truly ensure learning for all:

1. Implement intervention plans that provide students with additional time and support for learning as soon as they experience difficulty
2. Implement systematic processes to ensure students' learning needs are addressed schoolwide rather than according to the discretion of individual teachers
3. Implement timely procedures to identify and respond to students who need additional time and support
4. Implement directive interventions, meaning students are not *invited* to receive additional support but rather are *required* to receive additional support

This collaborative team process, with its grade-level sessions focused on mathematics lesson planning and the development and analysis of common assessments, is designed to support you in implementing a systematic and timely system of intervention for all students in need of such assistance.

RTI should not be viewed as a program "but rather [as] a system for meeting all students' needs" (Buffum et al., 2009, p. 23). One of the most effective interventions in mathematics at the K–8 level is an approach to instruction that carefully monitors student acquisition of the agreed-on curriculum based on collaboratively designed formative assessments. Ideally, the "formal" formative assessments (recall that formative assessment is a continual process) should be administered at least once a week, with the results of those formative assessments used to form smaller groups of students who should receive *additional* instruction in the skills and concepts with which they are struggling (Baker et al., 2002).

Much of the required targeted additional instructional support will occur during Tier 1 core instructional time (see chapter 5). However, the evidence is clear concerning the positive impact of providing students with an additional period of well-targeted mathematics instruction at the elementary level when it is necessary at Tier 2 and Tier 3 (Slavin & Lake, 2008). But this is the important point: the well-targeted supplemental instruction must take place *in addition to* whole-class instruction instead of *in place of it.* Interventions need to be supplementary in nature and not replace the core program but instead provide additional, more targeted instruction in the core concepts (Buffum et al., 2009). In too many cases, traditional elementary school interventions have failed because they are not done *in addition to* whole-class instruction but *instead of it.* The RTI-tiered preventative approach is designed to minimize the number of students who require Tier 2 or Tier 3 intervention in your PLC.

When students struggle in mathematics, as teachers we traditionally respond in one of two ways:

1. We slow the pace of instruction for all students until each student has enough time to master content—"going as fast as the slowest student."
2. We "cover" the content—racing through it and ignoring the fact that some students "get it" while others do not.

Given the accountability requirements of No Child Left Behind (NCLB), racing through the curriculum without ensuring that students have demonstrated mastery of essential content is no longer an option. This is one of the positive consequences of NCLB. But slowing down the pace of instruction is not a viable alternative. All too often, schools that serve large numbers of struggling students emphasize slowing down the pace of instruction and end up teaching less mathematics content to the very students who most need more instruction in order to learn more content (Walker, 2007).

Strategic efforts must be made to ensure that all students have an opportunity to learn the agreed-on grade-level curriculum and simultaneously guarantee each student the instructional time and support he or she needs to learn it well. Intervention time must be allocated from within the regular school day. There are as many different ways to find the additional instructional time needed for Tier 2 or Tier 3 interventions during the school day as there are schools. Compacting the curriculum can provide the additional mathematics instructional time recommended in the models in figure 1.3 (page 22). The same focus and coherence applied to the CCSS for mathematics curriculum need to be applied to all subjects in the elementary curricula.

There is simply too much content in the elementary school curriculum, both within subjects and across subjects. Selecting and focusing on fewer essential standards can free up the time necessary for a daily differentiated instruction block in mathematics (Schmoker, 2011). The bottom line is that in instrumental subjects—reading, writing, and mathematics—instructional time must expand so that the learning becomes constant for all students (Buffum et al., 2009). Figure 1.3 describes four successful models for finding additional instructional time for mathematics intervention in grades 3–5.

Model One: Additional Total Mathematics Time That Individual Teachers Administer

Some schools dedicate additional total time to mathematics instruction. For example, they allot only the equivalent of seventy-five minutes of daily math instruction in grades 3–5. However, teachers spend sixty minutes daily on new instruction and collect the "left-over time" to have a thirty- to forty-five-minute differentiated math block of time twice a week in which they address individual student needs based on weekly formative assessments. Individual teachers work with their own students.

Model Two: Additional Total Mathematics Time That Grade-Level Teams Collaboratively Administer

Other schools allocate time as in model one, but the teachers work as a team to regroup students so each teacher is not trying to teach as many topics to as many different small groups of students. The teachers meet in their grade-level collaborative teams to determine which students need additional instruction and support in what topics and then regroup the students during the differentiated instruction block. Teachers can then focus their reteaching on fewer targeted topics, and many of the students have the opportunity to learn the concept or skill from a different teacher.

Model Three: Curriculum Compacting to Gain a Weekly Intervention Day

Some schools compact the social studies and science curriculum in grades 3–5 by focusing only on the essential objectives, eliminating up to 20 percent of the curriculum. They then use this time to provide all students with a weekly period of additional mathematics instruction to meet individual needs.

Model Four: Compacting Curriculum to Gain a Daily Intervention Time

Some schools have left the traditional sixty-minute daily allocation for mathematics instruction intact but compacted other parts of the day to create a daily thirty-minute differentiated instruction block of time. In the most successful implementations, teachers meet in grade-level collaborative teams to identify student needs based on weekly formative assessments and regroup students so each teacher is teaching a smaller set of skills or concepts.

Figure 1.3: Intervention time models in grades 3–5.

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An advantage of the last model is that it allows one teacher in your collaborative team to use the differentiated instruction block to work with those students who have demonstrated high levels of proficiency with the content, permitting these students to study topics in more depth as well as to explore additional but connected concepts. When you work as a collaborative team to regroup students for targeted additional instruction and support (or extended learning), you also ensure every team member carries out interventions and that every student receives either necessary intervention or extended learning time, thereby removing all perceptions that intervention is a punishment. An additional benefit of the collaborative team approach to intervention is that you have the opportunity to brainstorm, share, discuss, and develop alternate instructional strategies to meet the needs of individual students. As Buffum et al. (2009) argue, “The vast majority of educators teach the very best way they know how. . . . Most teachers re-teach using the same instructional practices that failed to work the first time” (p. 68). Collaborative teams are uniquely structured to provide you the support and opportunity you need to expand and improve your instructional practices.

The Future of Mathematics in Your School

Transitioning to and implementing the Common Core State Standards is a one-time opportunity for you and your students. If the implementation of the CCSS is to move beyond the typical superficial implementation of previous reforms (Reys & Reys, 2011), then the implementation effort will require you to engage with your colleagues in an ongoing process of professional development and learning as a PLC. Well supported by research, this book outlines deliberate steps that you can take as you work with your colleagues to improve your own mathematics instruction, improve the quality of mathematics education in your school, and help all students develop a deep understanding and proficiency with Common Core mathematics. Your collaborative team functioning within the designed culture of a PLC is the most effective way to successfully improve mathematics instruction in grades 3–5 and meet the challenges of transitioning to and implementing the Common Core State Standards for mathematics.

As you begin to work together with your grade-level colleagues to plan more effective mathematics instruction, it will be critical that you focus on the CCSS Mathematical Practices. The Mathematical Practices (see appendix A, page 159) provide the overarching habits of doing mathematics that all learners at every grade level should experience. In the chapters that follow, we will unpack the Mathematical Practices and the CCSS content standards—and explore the role collaborative teams play in implementing and supporting all students’ successful acquisition of these new standards through highly effective instruction, assessment, and intervention practices. In addition, you will discover tools you can use in your collaborative team as you work to make the vision of the Common Core State Standards a reality for your students.

Chapter 1 Extending My Understanding

1. Compare the current model of collaborative professional development used in your school or district with Darling-Hammond’s (2010) definition of effective professional development (page 6).

    - How much time and during what time of day (before, during, or after school; late start or early release) is devoted to effective professional development each school year? Each month? Is this time spent in grade-level or vertical collaborative teams?

- What evidence exists to support or improve your existing model?

2. Discuss what an instructional shift toward higher levels of cognitive demand looks like in terms of mathematical tasks and measures of formative assessment. What is the relationship between higher levels of cognitive demand and the Mathematical Practices?
3. Examine the high-leverage instructional practices linked to the CCSS Mathematics Practices in figure 1.2 (page 15). How do these practices compare with the individual and group philosophies of staff in your collaborative team? How might you use this information to identify a starting point for your work with the Mathematical Practices?
4. Using figure 1.3 (page 22), discuss the advantages and disadvantages of each intervention time model. Which model for finding and using additional instructional time might work best in grades 3–5 in your school? What modifications in scheduling might be needed to implement these changes?

Online Resources

Visit **go.solution-tree.com/commoncore** for links to these resources.

- **"A Professional Collaboration Model" (Jenkins, 2010; www.nctm.org/publications/article.aspx?id=27410):** This article describes a well-defined structure to guide the efforts of grade-level collaborative teams as they work to promote positive changes to instructional practices.
- **The Center for Comprehensive School Reform and Improvement** (2009; **www.centerforcsri.org/plc/websites.html**): Here you can peruse a collection of resources to support an in-depth examination of professional learning communities.
- **Inside Mathematics (2010b; www.insidemathematics.org/index.php/tools-for-teachers/tools-for-coaches):** This portion of the Inside Mathematics website helps mathematics coaches and specialists support the professional learning teams they lead. Tools to support lesson study and teacher learning, including video vignettes that model coaching conversation, are available.
- **Inside Mathematics (2010c; www.insidemathematics.org/index.php/tools-for-teachers/tools-for-principals-and-administrators):** This portion of the Inside Mathematics website supports school-based administrators and district mathematics supervisors who are responsible for establishing the structure and vision for the professional development work of grade-level and cross-grade-level learning teams or in a PLC.
- **Learning Forward (2011; www.learningforward.org/standards/standards.cfm):** Learning Forward is an international association of learning educators focused on increasing student achievement through more effective professional learning. This website provides a wealth of resources, including an online annotated bibliography of articles and websites, to support the work of professional learning teams.