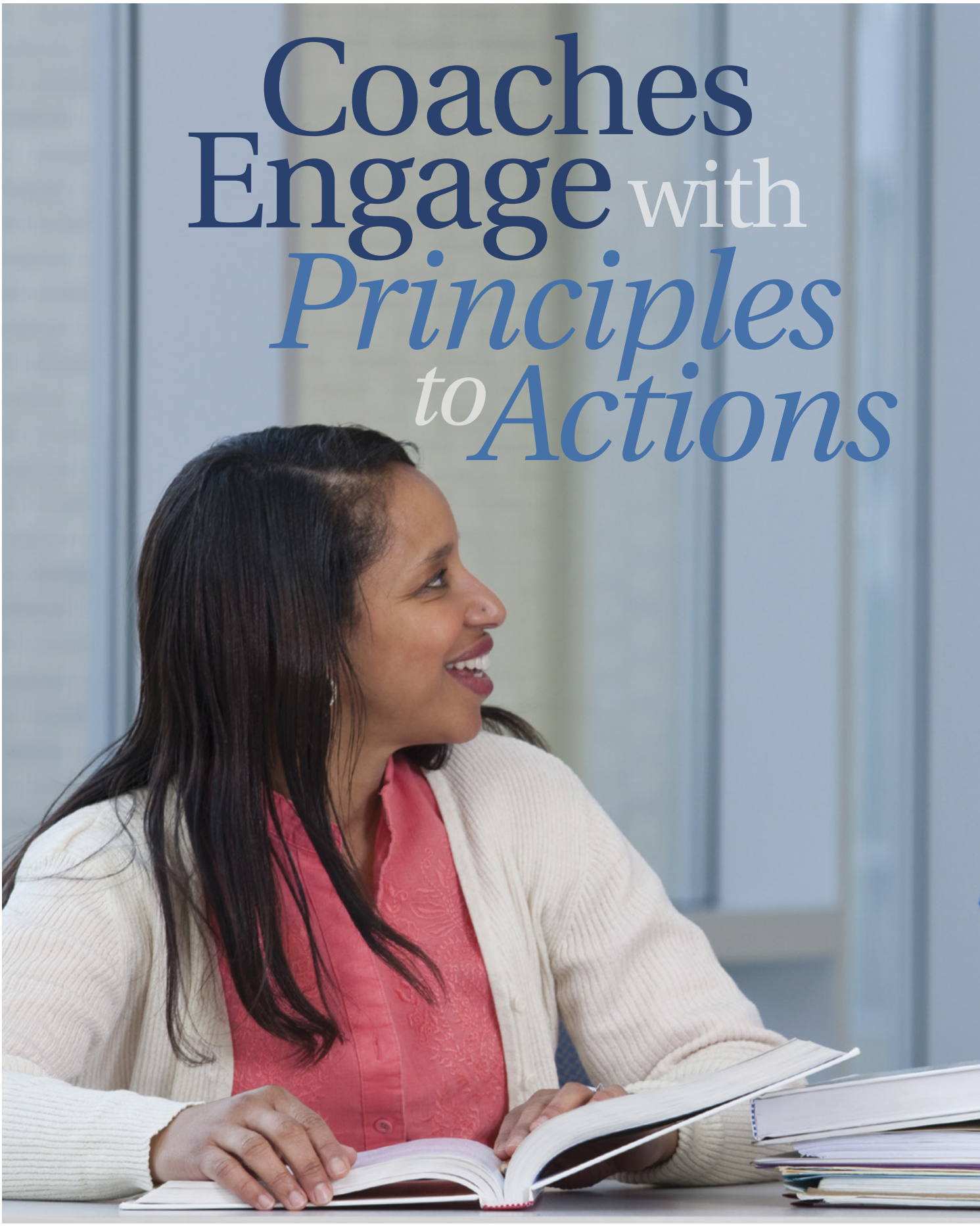
Coaches Engage with *Principles to Actions*



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Acknowledging the critical role of mathematics coaches in enhancing teacher capacity, positively influencing teacher beliefs, and increasing teacher investment in professional development, NCTM's *Principles to Actions: Ensuring Mathematical Success for All* (2014) calls on coaches to "take action." However, coaches seek guidance to meet the challenges of enacting the eight Mathematics Teaching Practices from *Principles to Actions* (p. 10) in their unique school contexts. To answer the call to action, mathematics coaches should not only support teachers in developing more "productive beliefs" but also establish new norms of instructional practice and create structures that encourage staff collaboration (NCTM 2014).

Because mathematics coaches have varying roles and responsibilities, we define a coach as anyone who is collaborating with teachers inside or outside the classroom to make instructional shifts. Whether working with individuals, teams of teachers, or administrators, mathematics coaches must continually adapt their approaches for varying levels of teacher knowledge and experience. We propose a decision-making tool that supports coaches as they work in conjunction with teachers and administrators to highlight the Mathematics Teaching Practices and to advance mathematics instruction for each and every student.

TABLE 1

Context-driven, content-specific questioning connects coaching practices and teaching practices in the four phases of the DMPMC.

The four phases of the Decision-Making Protocol for Mathematics Coaching (DMPMC)

	Bridging context and coaching practice	Bridging content and teaching practice
Phase I: Assess the coaching situation	**Understand coaching role** *What are the needs of your audience?* • Are you supporting individual teachers, grade-level teams, or an entire school? • What is the state of your relationship with each teacher? *What aspects of the school culture or strategic vision are essential in your thinking?* • What programs or initiatives have been implemented or abandoned recently? • What is the level of receptiveness to coaching?	**Define mathematics content focus** *What is your audience's experience with this mathematics content?* • What is the current state of teacher confidence? • What is current state of student thinking? • What instructional approaches have been tried? *What resources will support growth in teaching and learning?* • What representations will promote procedural fluency? • What representations will support conceptual understanding?
Phase II: Establish a coaching goal	**Synthesize situational knowledge** *What connections can you make between the needs of your audience, the mathematics content, and the goals of the team/school/district?*	**Envision changes in teaching and learning** *What are reasonable and realistic expectations for your audience?* *How will you measure your audience's progress?*
Phase III: Connect coaching goal to practice	**Select mathematics coaching practices (MCP)** *How will you negotiate and justify the choice of one or more MCPs?* • Which MCP best aligns with your coaching situation and your coaching goals? • What is your readiness to enact the identified MCP? • How will this MCP support you in creating a safe, low stakes learning environment for your audience? • What are the obstacles to this enactment that you will need to overcome?	**Select mathematics teaching practices (MTP)** *How will you negotiate and justify the choice of one or more MTPs?* • If the teachers are unfamiliar with the eight MTPs, how can you initiate and facilitate a conversation? • Which MTPs are most relevant in your coaching situation? • How will you gauge your audience's readiness to enact this MTP?
Phase IV: Reflect on enactment	**Evaluate progress toward coaching goal** *What evidence will you analyze?* *What were your successes?* *What are your next steps?* *How can you improve in your next coaching action?*	**Debrief and continue the journey** *How will you support your audience in moving forward on MTPs?* • What specific evidence will you share with your audience? • What words will you use when talking to your audience so that the mathematics and student thinking is at the forefront of the conversation?

A tool to empower math coaches

As former coaches, we reflected on the fluidity of our daily roles and responsibilities to create a tool that places mathematics content and context at the center of each coaching situation. Our Decision-Making Protocol for Mathematics Coaching (DMPMC) (see **table 1**) recognizes a range of coaching contexts, focuses on mathematics content, and aims to empower school communities to surmount obstacles as identified within *Principles to Actions*. Coaching actions should be grounded in the eight research-based Mathematics Teaching Practices and delivered through research-based mathematics coaching practices (Baker, Knapp, and Galanti 2017; Gibbons and Cobb 2017; McGatha, Davis, and Stokes 2015). These ideas are embedded within the DMPMC (see **fig. 1**) to assist coaches in iteratively understanding their roles in context, synthesizing knowledge of their unique situations, selecting appropriate teaching and coaching practices, and reflecting on their progress.

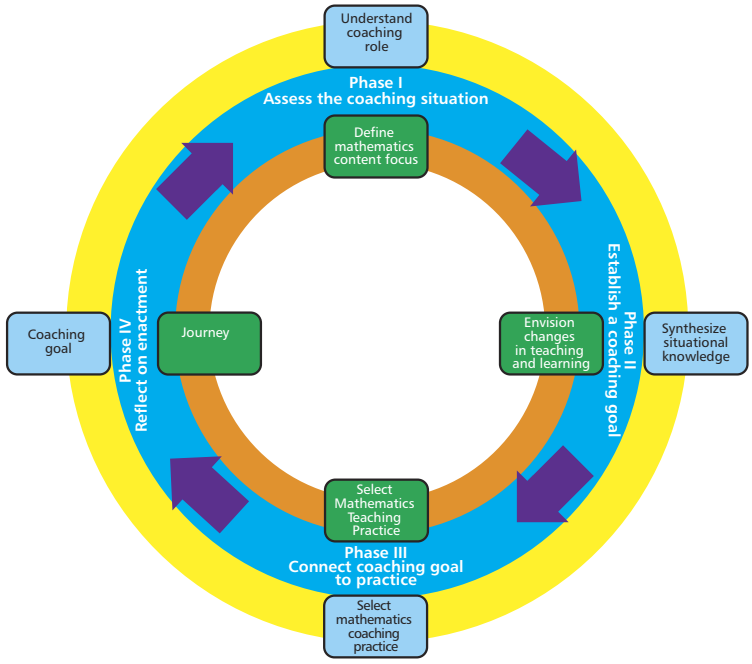
The DMPMC provides an intentional and reflective cycle of coaching actions to support classroom teachers as they strive to enact *Principles to Actions*. Math coaches respond to guiding questions to purposefully bridge context and research-based coaching practices to content and research-based teaching practices. As coaches become more skilled in supporting teachers in enacting the nuances of the Mathematics Teaching Practices (see **fig. 2**) in response to the specific needs of their communities, opportunities will emerge for students to more fully engage in reasoning and sense making.

The four phases of the DMPMC

Each of the four phases of the DMPMC connects coaching practices and teaching practices through context-driven and content-specific questioning (see **table 1**). Phase I of the DMPMC prompts coaches to assess their contextual situations, define the mathematics content, and highlight opportunities to improve student learning. Coaches integrate this contextual knowledge and content focus in phase II as they establish reasonable and realistic coaching goals for their teachers. Phase III provides a synthesis of practices identified by the coach as vehicles to connect coaching goals to meaningful mathematics learning. The debriefing of the coaching actions and classroom enactments during phase IV lays the foundation for continued collaboration in improving the teaching of mathematics. Coaches reflect on their actions within their coaching contexts using evidence of the classroom implementation of the Mathematics Teaching Practices and evidence of student learning.

FIGURE 1

With the Decision-Making Protocol for Mathematics Coaching (DMPMC) (Baker, Knapp, and Galanti 2016), math coaches respond to guiding questions to purposefully bridge context- and research-based coaching practices to content- and research-based teaching practices.



Using the DMPMC in varying contexts

Just as classroom teachers might piece together resources to meet a student's needs, a math coach may choose to use the framework in its entirety or select a specific phase that best meets his or her needs. For example, a novice coach may spend more time in phase I or II, understanding the school context, whereas an experienced coach who already understands the school context might work only within phase III. A coach's use of the cycle will depend on the needs of stakeholders within unique school contexts.

The following vignettes, taken from our experiences as math coaches, portray how the DMPMC can guide a coach's work with

FIGURE 2

Ideas are embedded within the DMPMC to assist coaches in iteratively understanding their roles in context, synthesizing knowledge of their unique situations, selecting appropriate teaching and coaching practices, and reflecting on their progress.

Mathematics teaching practices

Establish mathematics goals to focus learning. Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.

Implement tasks that promote reasoning and problem solving. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.

Use and connect mathematical representations. Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.

Facilitate meaningful mathematical discourse. Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.

Pose purposeful questions. Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.

Build procedural fluency from conceptual understanding. Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.

Support productive struggle in learning mathematics. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.

Elicit and use evidence of student thinking. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.

Source: NCTM, *Principles to Actions: Ensuring Mathematical Success for All*, 2014, p. 10

individual teachers, teams of teachers, and administrators.

Individual coaching goals and practice

The math coach is often the first line of support for the teacher who is enacting new practices. When working with an individual teacher, the coach can assess the situation by gathering data on current instruction, visiting the teacher's classroom, or engaging the teacher in conversations about instruction. Having analyzed the context, the math coach can make content-centered decisions to support student learning and to select appropriate Mathematics Teaching Practices (see **fig. 2**) and Mathematics Coaching Practices (see **fig. 3**).

The following vignette is a meeting between a math coach and a third-grade teacher who was working on the implementation of a high-level task that supported student reasoning and problem solving. Students had explored the relationship between area and perimeter by constructing a rectangular yard with a maximum area, given twenty-four meters of fencing (see **fig. 4**). This conversation between the math coach and a third-grade teacher named Jodi occurred during their collaborative postlesson analysis of student work.

Math coach: What do you notice about what students understand or what they are struggling with in the Fencing problem?

Jodi: I'm seeing that many of the students drew rectangles to represent the possible yard dimensions. Most of the students had the 1×11, 2×10, 3×9, 4×8, 5×7, but a lot of them missed the six-by-six-meter yard.

Math coach: Why do you think that is?

Jodi: Many of the students are not convinced that the fence they are to design could be a square. The problem says "to build a rectangular yard." I think they are unsure about what makes something a rectangle and what makes something a square.

Math coach: What would you want them to know about that mathematical idea? What do you think you can do to help them sort this out?

Jodi: I want them to know that a square is a special type of rectangle, so I think we should clarify what makes something a rectangle. Then they could use that definition to decide if a square yard is a possibility in this situation.

The math coach centered her work with this individual teacher on a task that required students to make sense of mathematical ideas and reason about the relationship between

FIGURE 3

Math coaches respond to guiding questions to purposefully bridge context and research-based coaching practices to content and research-based teaching practices.

Mathematics coaching practices

Engage in mathematics. Effective coaching of mathematics encourages collaborative discussions and problem solving to plan lessons, build content knowledge, anticipate or analyze student responses, prepare purposeful questions, explore manipulatives, select mathematics goals, and analyze the rigor and quality of the mathematics tasks. Engaging in mathematics within these activities deepens teachers' specialized disciplinary knowledge.

Examine student work. Effective coaching of mathematics facilitates collaborative conversations centered on examining student work samples to identify student understanding and misconceptions, to develop a shared understanding of student conceptualization of a mathematics topic, and to inform the next instructional steps.

Analyze classroom video. Effective coaching of mathematics guides conversations on shared teaching experiences to reflect on aspects of teaching. Videos can serve as representations that support teachers in learning and refining their practice.

Rehearse aspects of practice. Effective coaching of mathematics orchestrates preplanning of specific practices and conversations to provide opportunities to practice aspects of teaching and provide and receive feedback.

Engage in lesson study or studio day. Effective coaching of mathematics brings together groups of teachers, administrators, and/or instructional specialists in collaborative professional development. One or more cycles of lesson study or studio day may include planning a lesson, observing the implemented lesson, gathering student evidence, analyzing student data, and reflecting on the enactment and outcomes. These forms of professional development also provide opportunities for coaches to help teachers deepen their content knowledge.

Co-teach. Effective coaching of mathematics involves supporting teachers with delivery of instruction in the classroom. The coach and teacher work collaboratively to purposefully plan interactions to maximize student learning and enact particular practices to improve instruction.

Model instruction. Effective coaching of mathematics involves demonstrating for teachers the delivery of instruction in the classroom. The coach and teacher work collaboratively to purposefully highlight coach-student interactions to maximize student learning.

Adapted from Baker, Knapp, and Galanti 2017; Gibbons and Cobb 2017; Teachers Development Group, 2010.

area and fixed perimeter (3.MD.D.8). Grounding conversations in mathematical content and in evidence of student's mathematical thinking is a central theme in the DMPMC. By selecting to examine student work as her mathematics coaching practice in phase III, the coach purposefully questioned the teacher to consider evidence of student reasoning and to recognize that students had not yet had an opportunity to create generalizations about fixed-perimeter problems. The coach then suggested that the teacher choose an additional goal for the next day's lesson that would allow students to generalize and justify the underlying mathematical concept.

Productive team conversations

The following vignette is a prelesson observation conversation with a group of eight grades 3–5 teachers and their principal. The math coach selected Engage in Studio Day as her mathematics coaching practice because she had noticed

FIGURE 4

After third graders had explored the relationship between area and perimeter in the Fencing problem by constructing a rectangular yard with a maximum area, their teacher and a math coach did a collaborative postlesson analysis of student work.

The Fencing problem

Ms. Brown's class will raise rabbits for the spring science fair. Students have 24 meters of fencing to build a rectangular rabbit pen for the rabbits.

1. What are all the diferent sizes of rabbit pens that the class can build using all 24 meters of fencing?
2. If Ms. Brown's students want their rabbits to have as much room as possible, how long would each side of the pen be?

CCCSS.Math.Content.3.MD.D.8—Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Source: CCSSI, *Common Core State Standards for Mathematics,* 2010, p. 25.

that many of the teachers were not allowing students to wrestle with challenging tasks long enough before stepping in to provide scaffolding and support. Supporting productive struggle was chosen as the mathematics teaching practice focus for the third of four math studio professional development days planned and facilitated by the math coach. Prior knowledge of the teachers' practice helped the coach select a mathematics teaching practice that was both relevant to the coaching context and that aligned with the school's instructional needs.

Teachers had just finished reading the section about productive struggle in *Principles to Actions* (pp. 48–52). The coach wanted to build a foundation of knowledge for this collaborative planning, observing, and debriefing session.

Math coach: So, what does productive struggle look and sound like in the classroom?

Fourth-grade teacher: It looks like teachers providing high-level tasks that give kids something to actually think about.

Fifth-grade teacher: It sounds like teachers asking questions that promote deep understanding and acknowledging, valuing, and encouraging student talk and question asking. For students, it sounds like sharing, connecting ideas, and asking questions.

Third-grade teacher: For students, it looks like exploring multiple pathways and not stopping when you get stuck. Students need to get comfortable with not immediately knowing. That's hard, because sometimes they shut down when they are uncomfortable, and I feel like I should swoop in to "save them." How do I get past this?

Throughout this conversation and in the subsequent planning session, the math coach guided the teachers in identifying parts of the coming lesson where students might struggle with the mathematical concepts. Prior to their classroom visitation, the teachers used these critical points in the lesson to purposefully plan questions and consider anticipated student responses. The math coach then supported the classroom teacher during the lesson enactment by modeling questions and prompting students as they struggled with the task.

While the classroom teacher and coach supported students' productive struggle, the observing teachers collected evidence of critical moments in the lesson when students got past their stuck points or were unable to move on. After the lesson enactment, the math coach facilitated a discussion of evidence of productive struggle and ways to encourage student perseverance.

Math coach: Based on what you observed, how can we help our students to become comfortable with working through challenges? How can we support productive struggle?

Fourth-grade teacher: I should step back—fight the urge to rescue. I saw how the third-grade teacher did this during the lesson and the students actually worked past their stuck

→ reflect and discuss

Coaches engage with *Principles to Actions*

Reflective teaching is a process of self-observation and self-evaluation. It means looking at your classroom practice, thinking about what you do and why you do it, and then evaluating whether it works. By collecting information about what goes on in our classrooms and then analyzing and evaluating this information, we identify and explore our own practices and underlying beliefs. The following questions related to "Coaches Engage with *Principles to Actions*," by Courtney Baker, Melinda Knapp, and Terrie Galanti, are suggested prompts to aid you in reflecting on the article and on how the authors' ideas might benefit your own classroom practice. You are encouraged to reflect on the article independently as well as to discuss it with your colleagues.

1. According to NCTM's *Principles to Actions: Ensuring Mathematical Success for All*, principals, coaches, specialists, and other school leaders should "make the eight mathematics teaching practices a schoolwide focus that is expected for all teachers to strengthen teaching and learning for all students" (2014, p. 112). How does the DMPMC support this implementation?
2. How does the DMPMC support coaches or teacher leaders in their work with both teams and individual teachers?
3. How might the DMPMC help support coaches to engage in conversations with principals that focus on high-quality mathematics instruction?
4. How could using the DMPMC to purposefully reflect on one's coaching practice support the ongoing professional development needs of mathematics coaches and teacher leaders?

We invite you to tell us how you used Reflect and Discuss as part of your professional development. The Editorial Panel appreciates the interest and values the views of those who take the time to send us their comments. Submit letters to Teaching Children Mathematics *at* ***tcm@nctm.org****. Please include Readers Exchange in the subject line. Because of space limitations, letters and rejoinders from authors beyond the 250-word limit may be subject to abridgment. Letters are also edited for style and content.*

points on their own. I think I tend to jump in too soon. Rather, I should ask questions that will help them move forward.

Fifth-grade teacher: I want to help students know how to ask genuine questions of their partners or classmates when stuck or when making sense of ideas. Reminding students of this throughout the lesson seemed really helpful for students. By the end of the lesson, they began to do this on their own.

The coach chose to focus on a single mathematics teaching practice after observing teacher and student interactions before the professional development session. After identifying this instructional need, the coach structured the math studio day to co-develop the meaning and strategies that support productive struggle within the classroom. Teachers had already spent considerable time working on getting students to talk about their thinking, so a level of trust already existed about discussing this teaching practice together. The team unpacked the mathematical content as they co-planned the lesson. The observation and subsequent debriefing conversation provided evidence that guided the coach about how to further support implementation of supporting productive struggle with both individual teachers and with the team as a whole.

Administrators and other stakeholders

Coaches need administrative support as they develop rich, ongoing professional development opportunities for teachers that focus on instructional improvement. Principals can play a critical role in prioritizing these initiatives. The following vignette is a conversation between the math coach and the principal as they worked together to develop a system-wide perspective of school goals, curriculum, assessment, and data in a way that values the learning needs of the teachers.

Math coach: As you look at this list, which of these stands out to you as the highest needs for the teachers?

Principal: We've already done a lot of work with selecting high-level problem-solving tasks. Based on what I've observed, I know that students are not engaging in mathematical discussions. And when they are, the talk tends to be procedural. It seems like facilitating meaningful mathematical discourse and posing purposeful questions are areas we need to work on as a staff.

Math coach: Getting students to talk about mathematics is not always the norm in classrooms, so we need to change instruction to make it the norm. I like these two MTPs together because when teachers plan and ask good questions, math talk will follow.

Principal: Let's focus on these two MTPs during our next professional development session. I think teachers are ready for this type of work especially if they can see it in action. It is important that the whole school focus on these practices so the schoolwide norm changes.

Math coach: I like this idea. Let's design our upcoming math studio day to help teachers to start with planning lessons that give kids something mathematically worthwhile to talk about and carry over to our instructional practice of asking good questions that encourage mathematical discourse.

The principal and coach worked together to build capacity and focus on continuous improvement of instructional practice that is grounded in the needs of the students. Early in the school year, the math coach negotiated her role and set goals with the school administrators to ensure a coherent and cohesive collaboration. She intentionally referenced the eight Mathematics Teaching Practices as she centered the conversation within phase II of the DMPMC to develop a common vision for mathematics instruction in the school and then to propose professional development that attended to the needs of the students and teachers.

In subsequent conversations, the coach and principal could focus on the types of coaching work—either individual or team—that would best support the schoolwide goal. The coach used the DMPMC to connect research-based high-leverage teaching and coaching practices to school initiatives. She leveraged *Principles to Actions* to gain support for her work and ensure that the school leadership partnered in the ongoing development of teachers.

Conclusion

In each of the vignettes above, math coaches supported teachers and administrators to "ensure that all students become confident in their ability to learn and use mathematics" (NCTM 2014, p. 109). As a result, their actions not only advanced math coaching but also provided guidance that creates a cohesive vision for all school stakeholders. The guiding questions in the DMPMC challenge coaches to cycle through four phases of preparation and action that are generalizable to multiple situations and grounded in research and practice. Although the role of the math coach is often uniquely situated, the DMPMC is a tool for any teacher leader whose goal is to move mathematics instruction forward through enactment of *Principles to Actions*.

The DMPMC highlights how a math coach moves among content, pedagogy, and leadership. It advances coaching effectiveness by guiding any mathematics teacher leader to consider content, practices, and relationship building in tandem. It also communicates the important contributions of math coaches to other teachers and administrators who may be unaware of the power of content-specific instructional coaching. With the flexible knowledge and guiding questions of the DMPMC, math coaches can negotiate obstacles and support their schools in realizing the vision of mathematics teaching and learning that *Principles to Actions* proposes.

Common Core Connections

3.MD.8
SMP 1

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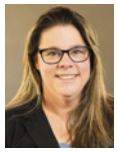

she works with teacher candidates and practicing teachers. She is interested in university-school district partnerships and professional development that supports prospective and practicing teachers in creating discourse-rich mathematics classrooms. **Terrie Galanti**, **tgalanti@gmu.edu**, is a doctoral student at GMU. As a high school mathematics teacher and engineer, she sees a mathematician in each and every student.

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Go to **http://www.nctm.org/tcm** to find a full-page appendix of the graphic in fig. 1. Access to this online material is a members-only benefit.