How to Use This Resource

Thank you for choosing the *Mathematics Discourse in Secondary Classrooms (MDISC)* resource for your professional learning experience needs. This section is intended to provide, at a glance, answers to why, what, and how questions about this resource. It describes the development team's goals in designing the resource, offers guidance for how to engage with the materials for the first time, and provides supporting resources that will be helpful before, during, and after your use of MDISC.

Why This Resource?

This resource addresses a pressing need in secondary mathematics education: the need to support *every* student to engage in richer, deeper mathematics discourse that positively impacts their learning of mathematics and their identities as mathematics learners. Rich mathematics classroom discourse is not always the norm in secondary classrooms. Traditionally, secondary mathematics teaching has been dominated by homework review, lecture, and independent practice; discourse in these classrooms has been characterized by teacher-driven interaction patterns that allow for minimal student contributions beyond correct answers. The Initiate-Respond-Evaluate (IRE) interaction pattern, for example, is dominant in domestic and international-comparative studies of secondary mathematics classrooms. In this pattern, student contributions are commonly limited to short responses that provide an answer to a problem and/or describe the procedural steps they used to arrive at that answer. Students who are perceived to be good at doing mathematics in such an environment are only those who produce correct answers quickly.

This portrait of secondary mathematics stands in sharp contrast to the guidance from teacher professional organizations over the last three decades related to student learning. The National Council of Teachers of Mathematics (1989, 2000, 2006, 2009, 2014), National Research Council (2001), and the National Governor's Association and Council of Chief State School Officers (2010) have clearly emphasized that conceptual understanding is a critical aspect of meaningful mathematics learning. All of these recommendations portray doing mathematics as a process of collaborative reasoning and sense-making. The materials connect meaningfully with current problems of practice in U.S. secondary classrooms, including practical and meaningful connections to the

Common Core State Standards for Mathematics as well as current research on effective teaching practice. As the recent *Principles to Action* (2014) argue, mathematics discourse that extends beyond IRE-style interaction patterns is necessary in classrooms to support students in learning meaningful mathematics, and coming away from their mathematical experiences with a conception of what it means to do mathematics that extends beyond speed and accuracy. In addition to mathematics teachers who want to become more purposeful about their classroom discourse, our pilots of these materials have shown that teachers looking for meaningful ways to meet the requirements of Response to Intervention (RtI) find the materials replete with rich content-based literacy strategies and meaningful formative assessment techniques.

What Is the Research?

The program materials were built from research-based frameworks from mathematics education, situated cognition, sociolinguistics, equity, and research on supporting students for whom English is an additional language to present a rich, nuanced set of ideas related to secondary mathematics classroom discourse. The materials feature attention to issues related to secondary mathematics, where the complexity of mathematical ideas and the associated language patterns increase significantly, when compared to students' earlier mathematics experiences. The MDISC materials are case-based, practice-based materials built from authentic artifacts of teaching practice, such as classroom transcripts and videos, secondary mathematics tasks, and student work. These cases provide groups of participants with opportunities to grapple with important ideas about mathematics discourse and how to support rich mathematics classroom discourse. The MDISC materials also provide natural bridges and connections to a number of popular frameworks and resources, including *Talk Moves* (Chapin, Anderson, & O'Connor, 2009),* the Mathematical Tasks Framework (Stein, Smith, Henningsen, & Silver, 2009), the Five Practices for Orchestrating Productive Discussions (Smith & Stein, 2011), and action research on mathematics classroom discourse (Herbel-Eisenmann & Cirillo, 2009). Additional short readings are suggested throughout MDISC that might be used with participants at various points in time.

Also see the section, *Rationale for Resource*, on page xxx, which further provides research-based documentation that supports the need for and the approach taken by the MDISC professional learning program.

* Chapin, Anderson, and O'Connor's most recent version of this framework was published in 2013; however, we drew initially on the 2009 version. The material presented here maintains connections to the current (2013) version. These connections are noted when appropriate.

Who Is the Audience?

These materials position both facilitators and teachers as professionals who have made a commitment to teach mathematics in ways that emphasize conceptual understanding and that open up spaces to support students as mathematical learners. The materials have a strong mathematical focus, and the activities are designed with teams of teachers in mind—for example, an entire mathematics department of a school could come together to learn about and support one another as they incorporate these ideas into their teaching. All professionals who work with students in mathematics, including special education teachers and teachers serving students for whom English is an additional language, will bring an important perspective, and the entire group as well as individuals will benefit from their participation. Teachers across a district might find it helpful to share experiences with colleagues working in different contexts as they individually try out these ideas in their respective classrooms.

The MDISC materials are most effective amongst a group of teachers with some common ground (such as in the same district or region), but also with some diversity (such as the grade levels taught or years of experience). The MDISC materials have been piloted successfully with both early- and late-career teachers and with both individual schools within districts and large districts or regions.

You do not need to know about discourse to use these materials. The MDISC materials provide facilitators (and teachers) significant opportunities to learn about the nature of discourse, its role in mathematics classrooms, and the concepts of PRODUCTIVE, POWERFUL, and PURPOSEFUL classroom discourse. The most important characteristic of a teacher who will be successful with the MDISC professional learning experiences is a growth mindset or strong learning disposition toward their own practice. Teachers who are interested in learning more about their own practice and implementing changes to it will be excellent candidates for the work. Familiarity with contemporary education standards such as the Common Core and professional frameworks like the Mathematical Tasks Framework and the Five Practices for Orchestrating Productive Discussions are helpful, but not strictly necessary.

How Is This Resource Organized?

This resource is organized for both novice and experienced professional learning facilitators to feel supported and confident in creating a professional learning environment for participants. As with any good professional learning, the MDISC professional learning sessions are intended to reflect and model the sorts of classroom practices that the materials promote. As you engage teachers in

work on mathematical tasks, analyses of transcripts and video cases, discussions of student work, reflections on readings, and the sharing of their own classroom artifacts, consider how you, as a facilitator, might purposefully foster meaningful discourse, position teachers in positive ways that will strengthen their identities as mathematics teachers, and use tools such as the Teacher Discourse Moves and Communication Contexts during professional learning sessions. We scaffold this work in important places in the materials, but acknowledge the fact that your own facilitation of MDISC is likely to make use of these tools and lenses in ways that we could not anticipate.

The Components

The Facilitator's Guide

This facilitator's guide contains constellations, which are the core of the resource and provide everything needed for professional learning sessions. Like a cluster of stars (a constellation), each unit is organized as a set of related learning activities, drawing on classroom-based artifacts (e.g., classroom videos, student written work, textbook excerpts) that are anchored by a high-level mathematical task. The constellations in the facilitator's guide are:

Constellation Getting Started

This constellation, meant as an introduction, engages participants in working on mathematics together, helps to talk about norms and community for this professional learning, and gets participants to begin to consider their classroom practices and beliefs, as well as articulate what "discourse" means for them at the beginning of this work.

Constellations 1–5

Constellations 1 and 2 introduce the primary discourse-related concepts and tools this professional learning program centers on. Constellations 3 through 5 provide opportunities to revisit and explore these concepts and tools in deeper ways by considering planning and facilitating discourse in small-group and whole-class discussions.

Constellation Capstone: Engaging in Action Research Projects

This final constellation supports participants in reflecting on their professional learning experience as a whole. It prepares them to begin to engage in cycles of action research to become increasingly purposeful about engaging students in PRODUCTIVE AND POWERFUL discourse.

Each constellation offers detailed support at multiple levels for facilitators, including:

- take-aways (ideas that participants will hopefully "take away" from engaging with the materials);
- facilitator preparation notes (such as suggested articles for reading);
- agendas and workflows (that include summaries of what participants will do, materials needed, and time approximations);
- activities (tasks that focus on the mathematics and teaching mathematics);
- cases (narratives in written, audio, or video form that highlight teaching practices);
- anticipated participant responses; and
- appendices (that include additional materials).

The Participant Guides

Each constellation offers a participant guide. The participant guides are digital products only (full-color PDF files) and can be downloaded by registering the product according to the steps on page xxviii. Participant materials appear as thumbnail versions within each constellation, for easy reference.

Video and Audio Clips

This resource contains five video clips and one audio clip as part of the narrative cases. The cases are intended to provide opportunities to investigate practice, to spur discussion of the key ideas in the MDISC materials, and to provide a lens through which teachers might view their own practice. They are not offered as exemplars—they are complex portraits of practice in which teachers are likely to find ideas that resonate with them and ideas that do not.

Each case is drawn from a teacher study group teacher's classrooms. Some of the video records are class sessions that the project team recorded using a professional camera and multiple microphones. Some are recordings that teachers made themselves from a single camera angle with only one microphone. Narrative cases were created where the video records were not of sufficient quality to use, or where the author team wanted to draw from more than one class session to create a composite that better highlighted the key ideas in the surrounding activities. With the direct and composite narrative cases, the authoring team took great care to use as much of the authentic classroom interactions as possible, editing primarily for clarity and flow. As such, the set of cases we include here represent authentic classroom practice across a range of teaching contexts. As the team wrote the cases, we checked back with the teachers to make sure that the excerpts, whether video or narrative, and the surrounding text that describes the context of their class and their goals captured their teaching practice in authentic ways.

Guidelines for Watching Videos of Teaching

The teachers who agreed to be recorded in these videos have complex and challenging classrooms, just like you. When we watch videos of others it is easy to see things that we might do differently. It is then all too easy to move to a critical stance, focusing on what the teacher "should" have done differently. But we have found that such a stance is not helpful for learning. These videos are not scripted or rehearsed. They are real classroom sessions. Remember that teaching is a complicated activity, in which the teacher is required to do many things at once. As you watch these videos, alone or with others, we recommend following these rules:

1. Assume that there are many things you don't know about the students, the classroom, and the shared history of the teacher and students in the video.
2. Assume good intent and expertise on the part of the teacher. If you cannot understand their actions, try to hypothesize what might have motivated them.
3. Keep focused on your observations about what students are getting out of the talk and interaction.
4. Keep focused on how the classroom discourse is serving the mathematical goals of the lesson. (Chapin, O'Connor, Anderson, 2013, xxi)

A Note About Positioning Teachers and Students in the Discussions

The MDISC materials and some of the constructs within them have the potential to raise difficult issues and challenging topics for teachers. In particular, the notion of *positioning* has often, in our experience, created opportunities to discuss issues of equity and tracking, race, the achievement gap, gender, and relationships between these constructs and the work of teaching. An increased awareness of positioning also frequently brings with it increased scrutiny related to language choices of teachers in the professional learning experiences. For example, after discussing how the language we use positions students as more or less capable, the phrase "my low kids" might become problematic for some teachers if it is used in the context of the professional learning experiences.

As a facilitator, we suggest that making these constructs an explicit focus for discussion when they arise can be a highly productive means to support teacher growth. The language of positioning provides you with opportunities

to contextualize these conversations—that is, it is worth discussing a difficult topic like how we talk about tracking because tracking implicitly and explicitly positions students in specific ways, which can have long-term impact on students' developing identities.

In our experience working with these materials with diverse groups of teachers, these conversations are both challenging and highly rewarding. At times, disturbing this sort of language makes sense in the moment by asking for clarification: "Can you say what you mean by *low kids*?" At other times, you may want to take time between sessions to consider how best to address an issue and consider priming that discussion with a teacher or group of teachers if necessary. For example, if a teacher is consistently using language that equates their students for whom English is an additional language with low achievement levels, it may make sense to have a brief discussion with the teacher before bringing the issue to light for the entire group. Although tracking is a common practice in schools, for example, there is little evidence that the results of tracking are best for student learning. Rather, tracking creates groups of students who are designated as "low" because they have not been successful in the system the way it is. Naming tracking as creating such groups and raising issues about the results of tracking can help shift the focus from students being incapable or unable to learn and make it more about how the system can be causing this to happen. If the goal is to create POWERFUL AND PRODUCTIVE discourse in schools, the language used to talk about students (and teachers) has to come from a place that focuses on strengths, not deficits.

You can see a few brief narrative/video examples of how we and our pilot facilitators have navigated those difficult conversations on our website. We encourage you to reach out to the MDISC online community (www.mdisc.org) also to discuss ways to handle challenging conversations.

PowerPoint Slides

This resource also includes a PowerPoint presentation to further help with facilitating the sessions. Callouts throughout the constellations correspond to the slides. To download the presentation, follow the product registrations steps on page xxviii.

How to Access Participant Guides, Video and Audio Clips, and PowerPoint Slides

Readers have several options for accessing the video and audio clips. Either scan the QR code (with a QR code reader app of your choice) that appears within the clip section in the text or enter the corresponding URLs in your browser. If you would like to access all the clips at once, follow these instructions:

1. Go to mathsolutions.com/myvideos and click or tap the Create New Account button at the bottom of the Log In form.
2. Create an account, even if you have created one with Math Solutions bookstore. You will receive a confirmation email when your account has been created.
3. Once your account has been created, you will be taken to the Product Registration page. Click Register on the product you would like to access (in this case, *MDISC*).
4. Enter key code and click or tap the Submit Key Code button.
5. Click or tap the Complete Registration button.
6. To access clips at any time, visit your account page.

Once you have registered your product, and are logged in to your account page, select the MDISC product and you will see a list of resources available for download on that page. To download the Participant Guides (PDFs) or PowerPoint Slide Presentation, simply click on the titles of the files you would like and the hyperlinks will take you to the item to download.

How Much Time Will This Take?

The most effective professional learning happens over time, in conjunction with opportunities for teachers to try out new ideas in their classrooms. For these sessions to have the highest degree of success, both facilitators and teachers must engage in advance planning, engagement with readings and materials, and meaningful reflection on the professional learning sessions and ongoing changes to teaching practice.

The core of the MDISC materials consist of approximately 30–40 hours of professional learning experiences in a study-group format. We have also used them in our methods courses for secondary mathematics teachers and in master's level courses for practicing teachers. In our work with pilot sites, we have found that the MDISC materials are most effective with professional learning sessions

that are at least two hours long, with between 2 and 4 weeks between sessions. The time in between sessions is important for two reasons. First, processing the key ideas and relating them to classroom practice takes time. Second, this allows for Connecting to Practice activities, in which teachers try some aspect of the MDISC work in their own classrooms, to be completed in a thoughtful manner. In addition, the materials are most effective during a school year rather than during a summer session in which participants do not have access to students and classrooms. We have, however, also piloted these as part of a summer experience. In these cases, we suggest asking participants to bring a short video clip of their classroom teaching and/or revisiting the Touchstone Documents during the first few months of school to have participants talk about the connections they are making between the ideas and their classroom practice.

The exact configuration of your sessions will of course depend on your participants and the schedules available to you. Some possibilities that we have found effective for implementing Constellation Getting Started through Constellation 5 include:

- twelve 3–hour afterschool sessions, once every 3 weeks
- six full-day (7 hour) sessions, once a month (October–March)
- sixteen 2.5-hour afterschool sessions, once every 2 weeks

The materials conclude with the Capstone Constellation, which provides support for participants to design and enact cycles of action research presuming completion of the other constellations. Session scheduling can be more flexible during the cycles of action research, focused on regularly convening to share and discuss progress. In our pilots, we have found that having two monthly meetings to support participants' action research have worked very well.

Making the Most of Your Time: Preparing to Facilitate MDISC

We acknowledge that in education, we often have less time than we might like to prepare for professional learning experiences with teachers. The MDISC materials address complex and nuanced ideas, some of which are likely to be new to you as facilitators. Therefore, we offer some suggestions derived from our work with pilot sites as to how you might best spend your time in preparing for an MDISC session. Additionally, we strongly encourage reading the facilitator notes for each activity because they include information about the discourse-related ideas and provide insights into how to enact the activities (based on multiple pilots and feedback from other facilitators).

- *Read and engage with the Touchstone Documents before planning the first session.* These documents summarize important frameworks for the key ideas and discourse tools that thread throughout the professional

learning materials. It will be particularly important for you to begin using the Teacher Discourse Moves from the start of the professional learning experiences.

- *Take time to work through the mathematical tasks prior to facilitating sessions and then look at the solution strategies we include in each appendix.* Doing so will help you better interpret the solution strategies that the materials articulate and make strategic decisions that can help keep a session paced well.
- *For each Constellation, determine, in advance, which Connecting to Practice (CtP) activities you will use.* More CtP activities are provided than you will be able to use. As appropriate, we have found it effective to offer choices to participants about which CtPs to complete. The timing of the various CtP activities are suggested in the Agendas.
- *As you near the end of a Constellation, consider opportunities for teachers to reflect on learning and how you as the facilitator will transition into the new focus for the next constellation.* Some suggestions are made for these at the end of each constellation, however it's imperative to gauge what participants need and support them in those ways as you proceed.
- *Ensure that teachers have protected time to reflect and write in their MDISC Journals.* Keeping a Reflective Journal yourself, as a facilitator, can also be a key tool for making good choices about the enactment of sessions going forward.
- *Review the key take-aways for activities and the overall timing.* Together, these will help you make important decisions to keep the professional learning experiences moving. As teachers become comfortable with one another, they are likely to engage in more conversation, both on- and off-topic, which can extend sessions.
- *Consult and make use of the slides provided for the sessions.* Important reminders are contained in the notes section of the slides that are intended to provide just-in-time support for facilitators.

Rationale for Resource

This section provides research-based documentation that supports the need for and the approach taken by the MDISC professional program.

What discourse tools and concepts are central to these materials?

In these materials, we take the stance that it is important to focus on students' "opportunities to learn" and not just the more narrow version of learning that written assessments typically measure or evaluate. Following Gresalfi and Cobb

(2006), we define "opportunities to learn" as including *both* students' learning of mathematical content and discourse practices as well as the development of students' dispositions and identities as mathematical learners. In these professional learning materials, we incorporate a set of discourse-related tools for teachers to use in their practice, but we also articulate two discourse-related conceptual lenses through which teachers might interpret their use of these tools in relationship to these two types of opportunities to learn.

For the discourse-related tools, we have modified a set of previously identified talk moves (Chapin, O'Connor, & Anderson, 2009) as the centerpiece set of tools for participants to consider (for further description of the changes and rationale for them, see Herbel-Eisenmann, Steele, & Cirillo, 2013). These Teacher Discourse Moves (TDMs) include: Waiting, Inviting Student Participation, Revoicing, Asking Students to Revoice, Probing a Student's Thinking, and Creating Opportunities to Engage with Another's Reasoning. (See Touchstone Document 4: "Six Focal Teacher Discourse Moves" for more detail.) These TDMs can be used to open up the mathematics classroom discourse in many ways, providing support for more students to participate and to support more students to participate in mathematically productive ways.

The discourse-related conceptual lenses relate to teachers being purposeful about facilitating discourse that is both PRODUCTIVE AND POWERFUL. We use "productive discourse" to mean "discourse that provides students with opportunities to make meaningful mathematical contributions toward particular mathematical learning goals" (Cirillo et al., 2014, p. 142) and "powerful discourse" to mean "discourse that positions students as people who are capable of making sense of mathematics and supports students' developing identities in terms of status, smartness, and competence in mathematics class" (Cirillo et al., 2014, p. 142). Thus, PRODUCTIVE AND POWERFUL discourse relate to the two opportunities to learn we explained at the beginning of this section. In order for teachers to gauge *how* the TDMs might be impacting their classroom discourse in relationship to PRODUCTIVE AND POWERFUL discourse, we incorporate work from sociolinguistics and socio-psychology, drawing heavily on research in these areas that focus on equitable discourse practices.

The discourse-related ideas that help us consider PRODUCTIVE AND POWERFUL discourse include: the Language Spectrum (and its related ideas of communication context and Mathematics Register) from sociolinguistics; and Positioning, from socio-psychology. Additionally, we draw on equity-related work in these areas and in sociology to draw attention to issues of authority, agency, smartness, and competence. For more about these particular constructs, see Touchstone Document 2: "The Language Spectrum"; Touchstone Document 3: "The Mathematics Register and Some Challenges It Poses"; and Touchstone Document 5: "Positioning in Mathematics Classrooms," which include more detailed information about these ideas.

Why these particular ideas and theories about mathematics classroom discourse?

Tools That Open up Mathematics Classroom Discourse: Teacher Discourse Moves

The Teacher Discourse Moves were developed based on previous work done in Project Challenge. In this project, Chapin, O'Connor, and Anderson (2003) supported grades 4–7 mathematics teachers to use a well-planned curriculum* alongside thoughtful incorporation of specific "talk moves." The teachers with whom they worked taught in urban schools that enrolled primarily students from low income and linguistically diverse backgrounds. In this project, the Principal Investigators showed that students' ways of talking and reasoning in mathematics changed dramatically in both qualitative and quantitative comparisons (Chapin & O'Connor, 2004; Chapin et al., 2003). For example, scores on the Test of Mathematical Abilities–Second Edition (TOMA-2) increased from 4 percent superior and 23 percent above average to 41 percent superior and 36 percent above average after two years of discourse-intensive professional learning work. Additionally, our previous work with secondary mathematics teachers independently indicated that these discourse tools had leverage for changing practice and student learning (Herbel-Eisenmann & Cirillo, 2009). The teachers with whom we worked, however, wanted to have some criteria for interpreting what seemed to happen when they used these moves. Thus, we searched for discourse-related conceptual lenses previously identified in research as being important to consider in classrooms, with the goal of considering PRODUCTIVE discourse and POWERFUL discourse. This search led us to the ideas of Language Spectrum (for attention to PRODUCTIVE) and Positioning (for attention to POWERFUL).

Productive Discourse Lenses: The Language Spectrum and Mathematics Register

The idea of the Language Spectrum** is based on the work of Pauline Gibbons (2003, 2006, 2009) in science education. This key idea has been used in multilingual classrooms in Australia and has been shown to be beneficial to teachers' scaffolding of students' facility with scientific discourse. Thus, we adapted the idea for mathematics classrooms. We have found that teachers in our pilots mainly address mathematical discourse through having students record vocabulary words, asking them to commit these terms and definitions to memory, and then

* This was described as consisting of NSF-funded curriculum materials (*Investigations* and the *Connected Mathematics Project*), weekly quizzes, daily logic-problem warm-ups, and an emphasis on achievement as well as the productive use of classroom discourse where students were supported to speak and write explanations with increasing mathematical complexity.

** The term Gibbons used is *mode continuum*. We changed the name of the construct, based on conversations with our Advisory Board and the teachers with whom we collaborated.

expecting them to use these terms appropriately. Yet, as the Language Spectrum highlights, it is important for students to use language in many different ways in order for them to develop meaning for and facility with mathematical terms. Language learning does not happen as students passively sit, take notes, and listen to teachers lecture. Rather, students gain facility when they are allowed to engage in various "communication contexts"—when they work in small groups and talk about mathematical tasks; when they are asked to report out about their solution strategies to the whole class; when they are required to write up their solutions; and as they learn to read and make sense of mathematical texts in textbooks and other mathematics classroom handouts. Thoughtful incorporation of these various communication contexts is imperative toward students' learning to use mathematical discourse with meaning. (Further rationale is provided in Touchstone 2: "The Language Spectrum.")

In order for teachers to scaffold students' facility toward mathematical discourse, they need to have a nuanced understanding of the characteristics of that discourse. Yet, our pilots have found that secondary mathematics teachers attend primarily to the presence of mathematics vocabulary (Herbel-Eisenmann, Johnson, Otten, Cirillo, & Steele, 2015). According to the work of Morgan (1998), however, mathematics teachers implicitly draw on a range of characteristics of students' solutions when they evaluate student work, based on what they value. These characteristics and values are rarely articulated or scrutinized. Thus, in these materials, we engage secondary mathematics teachers in articulating aspects of what sociolinguist Michael Halliday has called the "Mathematics Register" (Halliday, 1978; see also Pimm, 1987). (See Touchstone 3: "The Mathematics Register and Some Challenges It Poses.")

Professional learning experiences and teaching that focus explicitly on academic language and developing students' mathematics register have been shown to be effective in supporting their participation in mathematics class (Brenner, 1998) and increasing their achievement on assessments (Khisty & Chval, 2002). In fact, emphasizing the nature of the mathematics register can help mathematics teachers focus on the *mathematics* in the classroom discourse, a focus that is complex because it is often easier to focus on social aspects of the classroom discourse (Nathan & Knuth, 2003). These are important aspects of communication to make explicit because teachers and other students also have been shown to treat students differently depending on whether or not they consistently use features of the mathematics register correctly (e.g., Esmonde, 2009). So, it is important for participants to be aware of the particularities of the mathematics register and to openly and intentionally support students' use of it.

Powerful Discourse Lens: Positioning

Having opportunities to learn mathematics relates to the ideas about PRODUCTIVE discourse, but also requires attention to how students position themselves and are positioned by others. Positioning is

> the ways in which people use action and speech to arrange social structures . . . recognizes that there can be multiple kinds of conversation happening in any mathematics classroom, each of which assigns fluid roles to the participants. (Wagner & Herbel-Eisenmann, 2009, p. 2)

When people interact, they constantly assign fluid roles to one another. These roles are not necessarily intentional, for example, when a teacher might only ask boys to explain or justify their thinking (e.g., Wickett, 1997), sending an implicit message that only the boys are smart enough to explain and justify mathematics. Students' positioning supports (and has consequences for) the development of students' learning disposition (Gresalfi, 2009) and students' identity development (Anderson, 2009). In order for teachers to support students to see themselves as people who can know, do, and make sense of mathematics, they need to pay careful attention to students' positioning in the classroom. The words that are spoken and written in mathematics classrooms send students messages about who they are as learners, what mathematics is, what it means to know and do mathematics, and so on. Interactions are crucial to identity development and to how students are positioned: "Interactions simultaneously construct how students are positioned as people and as learners, and are a powerful indicator to students about how they are viewed" (Gibbons, 2006, p. 64). Positioning is important because it recognizes that authority, agency, and power are dynamic, always changing, and negotiated in interactions between people. Positioning is also constituted by valued artifacts (e.g., textbooks, see Herbel-Eisenmann, 2009) and how they are used.

We have found that when secondary mathematics teachers are provided meaningful educational experiences, they are able to make more PURPOSEFUL language choices in order to better support students' learning of mathematics (Herbel-Eisenmann & Cirillo, 2009). Using these key discourse-related tools and concepts, teachers can identify and change discourse patterns that they find to be unproductive and unaligned with their professed beliefs about teaching and learning mathematics (Cavanna, Herbel-Eisenmann, & Seah, 2015). Furthermore, when doing action research on classroom discourse, teacher-researchers can come to understand the challenges involved in trying to get students to participate in unconventional classroom interactions and better support students in a movement from a passive, transmission mode of communication to a mode in which they engaged in increasingly complex mathematical explanations, justifications, and argumentation (Herbel-Eisenmann & Cirillo, 2009). In the following

section, we provide a rationale for the particular decisions we have made about the broader design of the professional learning experience model we offer.

Why practice-based professional learning materials?

Meaningful change in teaching practice is challenging. All too often, practicing teachers are subjected to short-term professional learning experiences delivered by outsiders who desire for teachers to add to their classroom practice in particular ways. The professional experiences might involve the use of a new curricular resource, a pedagogical strategy, or a tool to support planning for and/or reflecting on instruction. If teachers cannot easily see how this new tool or strategy can fit into their teaching practice, it is unlikely that they will integrate the new idea into their work.

In contrast, educational researchers have identified features of effective teacher professional learning experiences that support meaningful change (Wei, et al., 2009; DeMonte, 2014; Gulamhussein, 2014). These features include that the professional learning experiences are long-term (greater than a year), grounded in theory, includes practice-based artifacts, provides implementation support, generative, and scalable. Ball and Cohen (1999) similarly describe that practice-based professional learning experiences, which makes use of the materials of and artifacts from teaching, provides opportunities to teachers to make these important connections. By using mathematical tasks, narrative and video cases, lesson plans, and student work that are derived from classroom practice, we increase the likelihood that teachers will be able to see images of their own work in the experiences. As such, teachers are more likely to transform their existing practice rather than to attempt to graft a new idea to their work that may or may not fit well with their existing routines and practices. For further discussion on the merits and importance of practice-based professional learning experiences, see Smith (2001).

Mathematics Discourse in Secondary Classrooms uses a particular type of practice-based materials that center on narrative and video cases of teaching. Using cases to support professional learning has a long tradition in fields like medicine and business, and these cases serve as prototypes against which one can compare and contrast their current practice (Shulman, 1986). Through this comparison, general principles about good teaching and learning can emerge. Cases provide rich detail about a classroom situation, which allows readers and viewers to experience the complexity of classroom practice, including teacher thinking and reflection as well as teacher and student actions. In the MDISC materials, PRODUCTIVE AND POWERFUL discourse and their associated lenses and tools (i.e., Language Spectrum [which includes communication context and the Mathematics Register], Teacher Discourse Moves, and Positioning) provide that framework in which the specifics of the case can be situated. Rich case discussions are crucial to the success of these materials. In particular, the analytical move of generalizing

from the specifics—linking the discussions about the classroom videos, student written work, and textbook excerpts—can help participants make connections to the broader theoretical constructs and to their own practice.

Understanding broader theoretical constructs and generalities about teaching, in turn, supports the cycles of action research that take place following the professional learning constellations in the MDISC materials. As participants consider principles that might support meaningful mathematics discourse in their classroom, action research structures support participants in systematically and thoughtfully using those generalities to conduct inquiry into their own teaching practice. Action research allows teachers to see their own practice as a series of cases, about which they can conjecture, reason, and continue to develop principles and practices that support strong discourse in secondary mathematics classrooms. *Mathematics Discourse in Secondary Classrooms* provides teachers with a rich opportunity to study classroom practice, experiment with new teaching tools, analyze their own practice through action research, and study ways in which they can meaningfully change their classroom practice and support stronger student outcomes.

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