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## Examining Potential Pitfalls that Hinder Productive Coaching Conversations

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### Abstract

*Instructional coaching is a popular approach for providing professional development to classroom teachers that can help to enhance their knowledge and use of effective teaching practices. A growing body of research on mathematics instructional coaching, and mathematics coaching in particular, suggests that coaches can both increase teacher self-efficacy and use of research based instructional practices and potentially have a positive impact on student achievement (Campbell & Malkus, 2011; Ellington et al., 2017; Knapp, 2017). To help ensure the effective implementation of coaching initiatives, researchers continue to examine the types of coaching practices that are most effective at creating these shifts. This paper adds to the literature on some of the challenges that coaches face in their planning conversations with classroom teachers and provides insights into how coaches and other mathematics education leaders can engage in productive coaching conversations that can foster reform-oriented shifts in teacher practice.*

### Introduction

In recent years, the focus on teaching K-12 mathematics has increasingly shifted toward an aim to “build procedural fluency from conceptual understanding” (National Council of Teachers of Mathematics [NCTM], 2014, p. 10), in classrooms where “...students are effectively engaged in learning mathematics” (National Council of Supervisors of Mathematics [NCSM], 2014, p. 1). Rather than focusing only on memorized procedures and rules, or solely on constructing meaning through inquiry, recent publications on mathematics teaching, as well as standards documents, strive for the development of conceptual understanding to meet an end goal of fluency with procedures and processes. In response to this shift, changes have been made to curricular materials, resources, and more importantly, the expectations for what constitutes effective mathematics teaching (Council Board for the Mathematical Sciences [CBMS], 2012; NCSM, 2014; NCTM, 2018). These changes often require teachers to adjust their existing instructional knowledge and practices, and to learn and incorporate new ways of teaching mathematics into their daily practice.

For example, current research informed teaching practices such as attending to the cognitive demand of problems to make them accessible yet mathematically challenging for students, force teachers to think about their role in developing and enacting curricula in ways they previously have not (NCTM, 2014; Smith & Stein, 2018). Other practices, like engaging students in discourse and making student thinking a central part of instruction, push teachers to shift toward a student-centered practice where instruction

was previously teacher-led (Chapin et al., 2013; NCTM, 2014, 2018). Although these sorts of ambitious teaching practices are promoted by mathematics researchers and educators at a national level (Ball et al., 2008; Carpenter et al., 2015; NCTM, 2014, 2018), helping teachers locally to envision and adopt them into daily practice can be challenging.

Studies suggest teacher professional development is a complex endeavor, one that should be situated within the context of the classroom, and embedded in real-time active learning, and utilize coaching/expert support as well as provide opportunities for teachers to receive feedback and reflect on practice (Darling-Hammond et al., 2017). Mathematics coaches present one potential avenue to provide contextualized support that is content specific. In this model of professional development, a knowledgeable teacher leader engages in planning with classroom teachers to facilitate engagement and reflection on effective mathematical teaching practices (Killion & Harrison, 2018; Knight, 2007; 2017; Sutton et al., 2011). Traditional professional development models, such as in-services and summer workshops, do not follow teachers back into their classroom practice, meaning the implementation of complex teaching innovations often meets with minimal transfer to long term practice (Darling-Hammond et al., 2017; Feiman-Nemser, 2001). Instructional coaching is often touted as a professional development model that has the potential to successfully mitigate some of these barriers by providing on site, in the moment supports that are tailored toward the needs of individual teachers (Campbell et al., 2013; Ellington et al., 2017; Knapp, 2017).

## *Examining the Literature on Mathematics Coaching*

### **Definitions of Coaching**

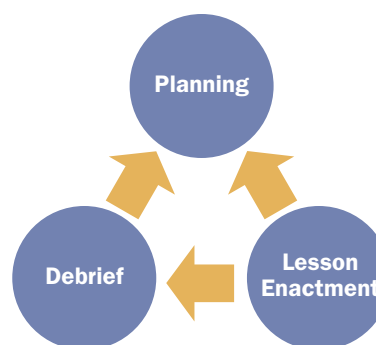
Instructional coaching is defined in a variety of ways in the literature. Killion and Harrison (2018) describe coaches as having as many as ten different roles that they may take up in their work with teachers. In addition to diversity in roles, there are also a range of instructional coaching models that coaches can subscribe to, including cognitive coaching (Costa & Garmston, 2015), instructional coaching (Knight, 2007; 2017), and content focused coaching (West, 2008). One common thread between these different coaching models is the articulation of an ongoing cycle of planning and discussion between coaches and teachers, which is embedded in daily teaching practice.

More generally in the literature, these coaching conversations are part of the “three-part coaching cycle” (Bay-Williams et al., 2014). As the name suggests, this cycle is comprised of three components: planning the lesson, data gathering/lesson observation, and debriefing or reflecting after the lesson. These cycle components are dynamic in nature, and coaches work flexibly within their contexts to engage teachers in this framework. Figure 1 illustrates this cycle as it is typically enacted in the professional literature.

FIGURE 1.

*The three-part coaching cycle.*

Adapted from *Mathematics coaching: Resources and tools for coaches and leaders, K-12* (Bay-Williams et al., 2014).



Despite commonalities in different coaching models, the literature shows that the extent to which an instructional coach has a positive effect on teacher practice or student learning is not always clear. The mixed results of previous studies aided in the framing of my own study of coaches, in order to find a focused lens within which to study their work with teachers.

### **Understanding the Nature of Mathematics Coaching as “Effective” Professional Development**

Although initial studies on the effectiveness of using mathematics coaches as a form of embedded, ongoing professional development were met with mixed results (Brosnan & Erchick, 2010; Campbell & Malkus, 2011; 2014; Chval, et al., 2010; Kretlow & Bartholomew; Murray et al., 2008), more recent studies highlight the potential of coaches to positively affect change. Mathematics coaching can lead to teachers’ successful implementation of research based instructional practices, which positively impacts student learning (Campbell & Malkus, 2011; Knapp, 2017). Similarly, Frazier (2018) and Taylor (2017) found

that coaching, and particularly mathematics coaching, can have a statistically significant impact on teacher competency/self-efficacy and student growth.

Simply installing a mathematics coach into a school is not enough to affect teachers' beliefs about mathematics instruction; studies have shown that teachers who are "highly engaged" with a coach make shifts in their perceptions about student learning in mathematics toward it being a sense making activity, and further coaches working with classroom teachers can translate to increases in student achievement (Ellington et al., 2017; Knapp, 2017). Understanding what makes for an effective mathematics coach is therefore a critical piece of the puzzle to ensuring the success of this type of professional development model. Schulte (2020) describes the need for coaches to have effective listening skills, questioning skills, and the ability to develop trusting relationships with teachers, and Russell et al. (2017) identify three key coaching practices: 1) engaging in deep conversations about the teaching and learning of mathematics that center on student thinking, 2) establishing clear content and pedagogical goals for coaching sessions, and 3) providing descriptive and evidence-based feedback to teachers. Russell et al. also present a framework for mathematics coaching that includes making pedagogical goals to help the teacher and coach achieve the mathematical goal of the lesson, then involves the teacher and coach engaging in "deep and specific discussion" of the lesson elements needed to support these goals (p. 154). Similarly, Desimone and Pak (2017) highlight five elements of effective coaching practice: a content focus, active learning opportunities for teachers, coherence in terms of content and goals, sustained duration, and collective participation within schools to develop a learning community. Such guidelines provide structure for instructional coach training programs and highlight important features of coaching implementation to maximize the potential success of these initiatives in a wide range of school contexts.

In examining how coaches can help to develop collective language and teaching practices, Gibbons et al. (2017) suggest that, during the deep conversations at the center of coaching practice, mathematics coaches should focus on using questions that are "carefully phrased" to help teachers attend to the mathematics and student thinking that are aligned to the goals of the coaching cycle. In terms of setting mathematical and pedagogical goals, the

authors state, "Some coaching designs instruct coaches to ask teachers what they want to work on or improve and respond to those requests. However, as teachers start to develop ambitious instructional practices, they may not be positioned to identify their own learning needs" (p. 248). This suggests the need for coaches to differentiate their coaching practice based on the knowledge, experience, and readiness of individual classroom teachers. It also highlights another coaching practice that studies have found to be important, the skill of shifting between monologic (meaning is fixed and disseminated to create common meaning) and dialogic (meaning is dynamic and co-created through conversation) talk with teachers to meet mathematics content and pedagogical goals (Gibbons et al., 2017; Ippolito, 2010). Recent studies suggest that using a combination of both monologic, or directive coaching, and dialogic, or responsive coaching, is important to engage teachers in reflection on and shifts in teaching practice (Sailor & Price, 2015). A case study by Hammond and Moore (2018) found directive coaching to be successful in generating increased use of target instructional strategies as well as increased teacher self-efficacy; the authors suggest the importance of limiting the amount of directive suggestions a coach offers to a classroom teacher for this approach to be effective. This article seeks to examine what coaches say and do during these deep conversations with teachers in ways that both align with and deviate from the suggestions in the current literature to help coaches better understand how to maximize their coaching conversations with teachers and avoid common pitfalls in this practice.

### *Developing a Theoretical Framework for Examining Coaching Conversations*

My study examined coaching conversations to look for instances where coaches helped classroom teachers attend to reform-oriented teaching strategies in their daily planning and teaching. I hoped to determine what coaches said and did that was more or less productive in helping teachers to reflect on and incorporate these strategies into their practice. To do so, it was necessary to clearly define what reform-oriented teaching strategies look like and find an appropriate framework to examine what mathematics coaches did to shift teachers' thinking and practice in productive ways. This section provides a definition of what is meant by effective mathematics teaching and details the development of an analytical framework for my study.

### Mathematical Teaching Practices

In response to the shifts in content standards and curricular materials toward reform-oriented practice, *Principles to Actions: Ensuring Mathematical Success for All* was published by NCTM (2014) as a guiding document for mathematics teachers. The authors describe the need for successful mathematics programs to have “...effective teaching that engages students in meaningful learning through individual and collaborative experiences that promote their ability to make sense of mathematical ideas and reason mathematically” (p. 7). To do this, NCTM outlines eight mathematical teaching practices (MTPs) to guide the work of classroom teachers:

- Establish mathematical goals to focus learning,
- Implement tasks that promote reasoning and problem solving,
- Use and connect mathematical representations,
- Facilitate meaningful mathematical discourse,
- Pose purposeful questions,
- Build procedural fluency from conceptual understanding,
- Support productive struggle in learning mathematics, and
- Elicit and use evidence of student thinking.

This document provides teachers, teacher leaders, researchers, and other stakeholders with a common language and set of expectations about what constitutes “effective” mathematics teaching. At a broad level, coaches can begin to help teachers envision what their instruction can look like and provide supports to help teachers make shifts in their practice toward reform-oriented strategies (Bay-Williams et al., 2013; McGatha et al., 2018). This broader framework provided the foundation from which the analytical framework for examining coaching conversations in this study developed.

### Mathematics Coaching Focal Areas

If a major goal of mathematics coaching is to help teachers incorporate the MTPs successfully into their practice, it is important for coaches to understand how they can maximize their time spent working with teachers. At the time of my study, research was just beginning to emerge on mathematics coaching frameworks that aligned well with my research questions, so I utilized research on effective teaching practices to develop an analytical

framework for my study (Ball et al., 2008; NCTM, 2014). To establish this framework, I first categorized the MTPs within three broader focal areas: teaching practices focused on the overarching mathematical goals of lessons, practices focused around problem design and implementation, and practices that help to bring to the surface the mathematical thinking of students (Jakopovic, 2017). This categorization is illustrated by Figure 2 and provides an overview of what it looks like for teachers to engage in effective mathematics planning and teaching.

FIGURE 2.

*Categorization of the mathematical practices for teaching into focal areas (Jakopovic, 2017).*

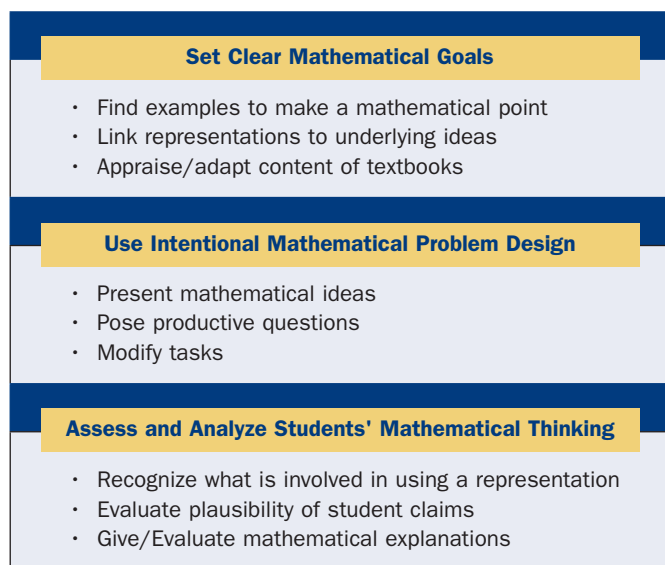
Set Mathematical Goals	Use Intentional Mathematical Problem Design	Assess and Analyze Students' Mathematical Thinking
Establish math goals to focus learning	Implement tasks that promote reasoning and problem solving	Facilitate meaningful mathematical discourse
Build procedural fluency from conceptual understanding	Use and connect mathematical representations	
Support productive struggle in learning mathematics	Pose purposeful questions	Elicit and use evidence of student thinking

According to Campbell et. al (2013), for coaching conversations with classroom teachers to be “productive,” a mathematics specialist must be able to “...make adjustments to her techniques as her familiarity with the teacher’s level of mathematical understanding evolves” (p. 21). Gibbons et al.’s more recent work echoes the need for flexibility and differentiation on the part of the coach (2017). As the coach learns which of the MTPs will become the focal points of their work with a particular teacher, they can adapt their coaching practice to tailor it to the needs of each individual.

To better understand how a coach might break down this work, I then examined what types of specific planning and instructional tasks teachers engage in that help them

to enact the teaching practices. To do so, I utilized the “mathematical tasks of teaching” developed by Ball et al. (2008) to classify the specific components of planning and instruction that are related to effective teaching practices. According to the researchers, teachers utilize specific types of knowledge to engage in a variety of tasks that pertain to the planning and implementation of mathematics instruction on an ongoing basis. These “mathematical tasks of teaching” (MTTs) require teachers to apply this knowledge in ways that are both specific and demanding in their daily practice. Similar to the MTPs, many of these tasks can be categorized more broadly as helping teachers to develop mathematical goals, design and implement lessons, and provide opportunities to examine student thinking. Figure 3 shows the nine MTTs that are well-aligned with the broader focal areas to help to illuminate what MTPs require to be enacted successfully. These focal areas and their underlying MTTs afforded me a framework for examining what teachers say and do during coaching conversations to determine what coach moves, if any, lead to reform-oriented and focused planning and teaching of mathematics.

FIGURE 3.  
*Categorizing Mathematical Tasks of Teaching within Teaching Practice Focal Areas*  
(Adapted from *Jakopovic, 2017*).



This framework is similar to the recent work of McGatha et al. (2018), which lays out a series of “professional learning focus areas” for mathematics coaches to attend to in their coaching conversations with teachers. As this paper will

discuss, having a coaching focus (or lack thereof) during these conversations can dramatically change the trajectory of the conversation with teachers. It is worth understanding what and how coaches do to engage teachers in both focused and unfocused conversations, so that coaches and other professional developers can enhance the potential effectiveness of this work.

## Methodology

The purpose of this qualitative study was to understand how mathematics coaches engage with teachers during coaching conversations to promote teacher reflection on the MTPs and MTTs in their daily practice. Like teaching, the work of an instructional coach is a complex practice (Bay-Williams et al., 2014; Ippolito, 2010).

This study was a single case study bounded by six elementary mathematics coaches from the same urban school district. Case studies allow the researcher to examine a contemporary and relevant issue, “in depth and within its real-world context,” often begins with a theoretical framework to guide data collection and analysis and utilizes multiple data sources to allow for triangulation of findings (Yin, 2017, p. 14). As the goal of my study was to better understand how these coaching interactions influence teacher practice and why certain coaching conversations are more effective than others, qualitative case study design was well suited to examine this work (Yin, 2017). I utilized participant-observation, field notes, and interviews with the coaches and select teachers, to triangulate findings during my data analysis.

The major question guiding my research was: How do mathematics coaches craft the conversations they have with teachers during planned three-part coaching cycles in the way that they do in order to promote teacher conversation about and engagement with research-based mathematics teaching practices? The conversations that occur within the three-part coaching cycle were chosen as a particularly prominent platform that coaches use to initiate deeper conversations with teachers to examine in this study. A secondary question that guided this research was: What are the questions, statements, and moves that coaches make to support teacher thinking and instructional planning around these teaching practices? Campbell, et al. (2013) and Gibbons et al. (2017) suggest that asking good questions is at the heart of the strategies that

coaches employ in their work with teachers. Mathematics coaches question teachers about student learning and about their practice. Coaches must know when to ask a question and when to wait for a better time and must be comfortable posing questions that have no immediate answer. Additionally, coaches can use other moves, such as offering suggestions and sharing examples, to help teachers think deeply about planning mathematics lessons that are centered on MTPs and MTTs. Developing a better understanding of the types of moves coaches make, and how they shape reflective conversations with teachers, can be fundamental to developing highly effective mathematics coaches. This study sought to analyze the sorts of moves mathematics coaches use during deep planning and reflection interactions with teachers to focus on MTPs and MTTs, and to what extent these moves appear to be successful in meeting these intended coaching goals.

### Participant Selection

The participants of this study were six elementary mathematics coaches in a large, urban school district. Funding for the coaches was provided by two local philanthropic organizations, and this study was situated within broader research of mathematics initiatives in the participating school district. As well as being experienced former classroom teachers, each participant coach completed a mathematics education graduate program prior to becoming a coach, and they received an intensive ten-day coaching training from the Examining Mathematics Project at the onset of their new role. The six coaches served a total of eight elementary schools at the time of the study. Many of the schools where the coaches served were labeled as “low achieving” based on the results of statewide assessments, with three of the eight schools achieving at less than 50% proficiency on the 2014-2015 statewide mathematics assessment. Most of the schools served students of low socioeconomic status (SES), with six of the eight schools having rates at 85% and above for students receiving free or reduced lunch (a common indicator for determining SES) at the time of the study.

A total of 25 coaching cycles were observed and recorded in the participating elementary schools, which included work with 20 teachers during the spring of 2015. The teachers ranged in experience from one to twenty years of experience. Amy, Candy, and Mary worked with 2 to 3 teachers each in their observed coaching cycles, while Alex, Sharon and Emily worked with 5 to 6 teachers each. All

coaches worked with a combination of beginning career teachers and veteran teachers with over 10 years of teaching experience. The backgrounds of the coaches also had some variability. Table 1 shows the background information on each of the coach participants at the time of the study.

Table 1: Participant Demographics at Time of Study

Coach Name*	Years Teaching Experience	Years Coaching Experience
Candy	10	3.5
Amy	17.5	1.5
Mary	16	1.5
Alex	10	1.5
Sharon	15	1.5
Emily	23	1.5

\*Pseudonyms were used to protect the anonymity of participants

### Data Collection

I collected a large sample of coaching cycles with the intent of illuminating the complex work that coaches do with teachers. During the spring semester of 2015, I gathered evidence from 25 total coaching cycles, 22 of which included a face-to-face debrief (two cycles included debriefs via email and one cycle did not conclude with a debrief). I audio taped and transcribed the observations of coaching conversations for later analysis. I maintained field notes during my observation of the coaching cycles to better capture a complete view of the planning and debriefing conversations by including data, for example, that the audio-recordings could not capture. I kept notes of the classroom environment, mathematics and ideas that were shared in writing (both during the planning and debriefing and during lessons), and notes about non-verbal communications that occurred during the cycles. These observations of coaching cycles were supported by brief interviews with the coaches to clarify background information about the teacher, previous coaching work, and their goals for and reflections on the coaching cycle, as well as end of semester interviews with the coaches and select teacher participants. The complete scope of my data collection is shown in Table 2.



Table 2: Data Collection Spring 2015

Data Sources	Quantity of Data Collected
Observations of planning conversations	27
Observations of debrief conversations	22
Brief, informal conversations with coach	39
Researcher field notes on coaching cycles	25
Extended final coach interviews	6
Final teacher interviews	8

### Data Analysis

I used qualitative methods to examine the data in two rounds of analysis. First, I coded transcripts of the planning and debriefing sessions for evidence of the Mathematical Tasks of Teaching (MTTs), to determine the types of teaching tasks that occurred in coaching conversations, as Table 3 illustrates (Ball et al., 2008). These teaching tasks illustrate the types of teaching moves that mathematics teachers engage in when trying to incorporate research-based instructional strategies. Specifically, I looked for instances of teachers discussing one of the MTTs during round one of coding.

Table 3: Definitions and Examples of Teacher Talk Coded as MTT (Mathematical Tasks of Teaching)

MTT	Definition	Example
<b>Presenting Mathematical Ideas</b>	Determining task design and set up (task, questions to pose, etc.). Determining, analyzing, or posing problems with the same/ different structures (Selling et al., 2016).	“I like your idea of giving them the problem and just saying, ‘Okay, I want you to try to work it out.’ And so that way they are kind of working with the numbers. I’ll give them time to try and figure it out, they’ll talk about it with a shoulder partner...then I can go through it and we can talk about reasonableness. You know, how four-fifths is really close to another whole, so really technically it’s almost two wholes there.”
<b>Finding examples to make a specific mathematical point</b>	Matching task/problem to goal of the lesson. Matching word problems with a particular structure (Selling et al., 2016).	“I guess [I’d] like to help them see that, I mean, in some sense they could just reduce this to find the least common denominator... So would it make sense to say, ‘Here’s our two-sixths, we’re adding one-third,’ and then have them see if they can determine, before we get into this problem solving piece when we’re just first introducing the idea of it, and having them sort of experiment to find a common denominator?”
<b>Recognizing what is involved in using a particular representation</b>	Anticipating benefits/drawbacks of using particular models for a given mathematical task. Anticipating how students might attempt to incorporate such models (both correctly and incorrectly). Selecting, creating, evaluating representations for a given operation or mathematical idea; analyzing representations for the same reason (Selling et al., 2016).	“I think a lot of my kids will figure that part out. Like, ‘Oh you can’t have that because the big number is on top,’...It’s just going to be tricky for them because I taught them how to change a mixed number to an improper fraction, an improper fraction to a mixed number. They’ve seen that. I think what’s going to be tricky for them is when they see the whole number out front right here and an improper fraction. That’s going to start to confuse them and they’re not going to know, ‘Well what do I do with 11 when I’m dividing?’”

MTT	Definition	Example
<b>Linking representations to underlying ideas and to other representations</b>	Making explicit links between symbols, concrete pictures, diagrams, etc. Utilizing multiple models and helping students see connections between models. Connecting mathematical terms and ideas to analogies/metaphors/stories intended to help students understand mathematical concepts. Connecting or matching representations- matching to operations, to other representations, comparing the validity of two representations (Selling et al., 2016).	“Should we let them explore to find an answer? See if they can find multiple representations for it and then just kind of take a look at them and write them up there, two-thirds, four-sixths, and eight-twelfths and see if we can notice anything about those numbers...We say, ‘Okay, these are what they are added together, what are we noticing about the denominators?’ Or, ‘What are we noticing about the numerators?’”
<b>Evaluating the plausibility of students/ claims (often quickly)</b>	Interpreting student ideas/claims (processing what they are saying and doing and offering appropriate feedback). Using and attending to student errors. Analyzing structure in student work (Selling et al., 2016). Making sense of student work in relation to instructional goals, mathematical structures, and multiple ways of solving (Kim, 2016).	“When we first start, you know, kids weren’t talking about much but now they’re eager to say, ‘I disagree with that,’ and, ‘Okay, well why do you disagree with that?’ ‘Well, I saw that I didn’t have enough so I had to regroup,’ today one of my students said. ‘I had to regroup the ones.’ When actually he had to regroup the tens, and I was like, ‘Really good job using the vocabulary. Let me make sure we’re regrouping the tens because we have a tens stick and we’re changing it...’”
<b>Giving or evaluating mathematical explanations</b>	Providing mathematical descriptions (with or without student help) that offer clear characterizations of the steps of a mathematical process. Teacher directing of explanations that includes attention to meaning (can include justification). Comparing, critiquing, and improving =mathematical explanations (Selling et al., 2016).	“They would say, ‘Well, we’re finding the difference,’ which it didn’t even say the difference in the problem. It said how many more. They’re like, ‘We know we’re finding the difference and the difference means the answer to a subtraction problem.’”

I then refined the coded MTT teacher comments to the three broader focal areas of mathematical goals, problem design, and student thinking in order to look for trends across the data and connect these teaching tasks to the research based mathematical teaching practices (MTPs) advocated for in the current literature (NCTM, 2014). Recognizing that these two categorizations of the “what” of mathematics teaching overlap in terms of these larger themes, or focal areas, allowed me to then shift to examining what coaches did, if anything, to facilitate this teacher talk and reflection around the focal areas (as Figure 4 illustrates) in my next phase of coding.

In round two of my analysis, I re-examined the coded excerpts for evidence of whether something the coach said or did precipitated these instances of teacher talk around focal areas. For this process, I utilized open and axial coding (Strauss & Corbin, 1990) because, even though “coaching

moves” have been broadly defined in the literature, little research currently examines the specifics of what coaches do and say to help teachers attend to MTPs and MTTs. Much of the current work is quantitative in nature, which can make it difficult for others to understand and replicate “productive” coaching conversations in their own contexts. Multiple current mathematics coaching resources tout that coaches help teachers to engage in the following: 1) setting goals, 2) posing ideas, 3) sharing ideas or suggestions, 4) actively listening, and 5) helping teachers to analyze student work (Bay-Williams et al., 2014; Campbell et al., 2013; Huguet et al., 2014). Through this second level of analysis, I used deductive and inductive methods (Saldaña, 2016) to develop a list of “coaching moves” from which I could examine the extent to which coaching conversations are more or less productive in helping teachers attend to these reform-oriented teaching practices (see Table 4).

FIGURE 4.  
*Aligning MTPs and MTTs to Three Broader Focal Areas*

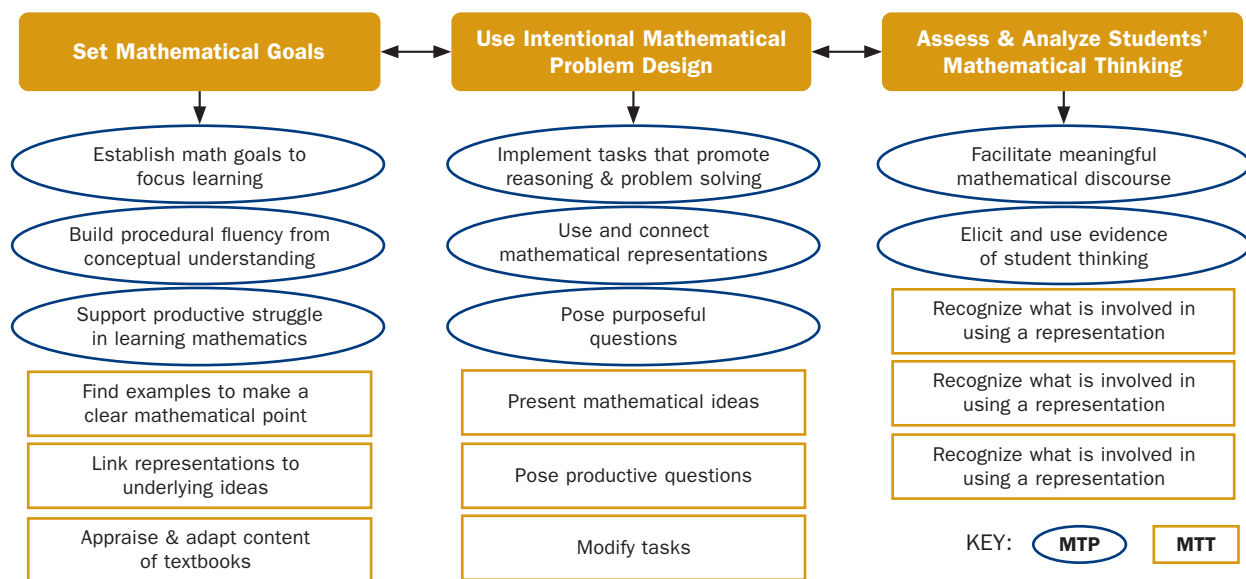


Table 4: Counts of Coaching Moves Coded for Mathematical Focal Areas

Focal Areas	Coaching Moves to Press Focal Areas	Coding Count
<b>Mathematical Goals</b>	QMG = Posing questions about mathematical goals	12
	QG = Posing questions about goals related to teaching	15
	SMG = Offering suggestions about mathematical goals	6
	RMG = Restating mathematical goals	14
<b>Mathematical Problem Design</b>	QPD = Posing questions about mathematical problem design	82
	QPS = Posing questions about the organization and set up of the problem/activity	14
	SPD = Offering suggestions about mathematical problem design	35
	SPS = Offering suggestions about the organization and set up of the problem/activity	8
<b>Students' Mathematical Knowledge/ Thinking</b>	QAS = Posing questions to anticipate student mathematical thinking/strategies	46
	QES = Posing questions about examples of student mathematical thinking/strategies	18
	QBS = Posing questions about student background knowledge of mathematics	16
	SES = Sharing examples of student mathematical thinking/strategies	25
<b>Unrelated to MTT Themes</b>	Q = Posing generic/other questions about the lesson	30
	SET = Sharing examples of teaching moves/collected data from lesson	4
	I = Interruption to conversation	6

In the final part of my analysis, I examined the extent to which categorizations of coaching moves coincided with the teacher making a remark that either focused on MTPs and MTTs or was more generically worded in response to the coach's move(s) (see Appendix A). I looked for trends in how the wording of individual coaching moves resulted in various patterns of teacher response, as well as how coaching moves across an entire conversation orchestrated more or less teacher comments attending to specific MTPs and MTTs. In addition to analyzing planning and debriefing transcripts, it was necessary to code and analyze my field notes and interview transcripts at this final phase of analysis. I cross-referenced the various data sources for each of these coaching conversations to better understand whether coaches had a particular focus walking into a coaching session, if they used a protocol to guide their coaching moves, and look for any other potential factors that might have influenced the direction of each conversation. Not only did examining a range of data sources help me to develop a better understanding of this complex work, it also allowed me to triangulate my findings in ways that increased the validity of my research (Yin, 2017). In particular, analyzing the brief interviews I conducted with coaches before and after each coaching session with a teacher allowed me to compare a coach's intended focus for the conversation with what actually occurred, and to hear the coach's perspective on how productive the coaching session was in helping the teacher engage in planning and conversation around the focal areas. For the purposes of this study, I use "more productive" to describe coaching moves that resulted in teachers reflecting on specific MTPs and MTTs during coaching conversations. I utilize "less productive" to refer to coaching moves that resulted in teacher responses that did not attend to MTPs and MTTs or that shifted the conversation in ways that became more coach-centered than teacher-centered (Appendix A).

## *Findings*

### **Coaching Moves**

In my data analysis, I found that coaches used a variety of coaching moves intended to help focus teacher thinking and planning around the three broader MTP focal areas, yet some of these moves were more productive than others in helping teachers attend to the focal areas. Understanding how coaching moves can guide the flow of conversation with classroom teachers and lead to teachers increased attention on the focal areas or not, can be instrumental in helping coaches learn how to maximize their time with teachers.

In the following section, I present several vignettes to illustrate some of this study's findings about potential barriers to productive coaching conversations that surfaced in my analysis, as well as provide examples of coaching moves that led to more productive work with teachers.

### **Unfocused, Surface Level Conversations**

One potential barrier mathematics coaches can face is a lack of focus in their coaching conversations with teachers. I categorized 8 of the 47 planning or debriefing conversations (from the 25 coaching cycles) as "less productive" due to a repeated lack of the teacher attending to MTPs or MTTs (see Appendix B). In my analysis I found that the coaching moves utilized in these conversations were often not worded in ways that specifically focused on MTPs or MTTs (i.e. "What are you working on?" versus "What is your mathematical goal for this lesson?"), follow up moves were not used to press teachers for further discussion after brief responses (i.e. "talk moves"), and the coaching moves often lacked focus on the focal areas.

As McGatha et al. (2018) suggest, having a professional learning area as a focal point of the coaching conversation can help coaches guide teachers in making connections to mathematical and pedagogical topics in manageable chunks during the coaching cycle. As Appendix B illustrates, often in these scenarios the coaching moves were followed up by teacher responses that were generic (i.e. not tied to an MTT or MTP), focused on logistics and organizational issues rather than the mathematics, or, rather than answering the coach's question, the teacher's response went on an unrelated tangent. When coaches and teachers engaged in conversations that did not have a clear direction related to one or more of the focal areas, and coaches did not keep the flow of the conversation focused on these themes, it tended to result in a sparse amount of teacher talk about MTTs or MTPs. In other words, the conversation did not go "deep" (Russell et al., 2017), rather tended to scratch the surface of topics related to the lesson. In these more surface level conversations, even when coaches did use coaching moves that were specific to the focal areas and teachers did not respond in kind, there were seldom follow up probes used by the coach to make further attempts to engage the teachers in conversation around mathematical goals, problem design, and/or student thinking. Additionally, when half or less of the coaching moves were specifically worded around focal areas, teacher responses were likewise focused on effective teaching practices less than 50% of the time.

To help illustrate this, Vignette 1 provides an example of one of these “less focused” conversations. Vignette 1 occurs after the coach, Amy, observes a 2nd grade math lesson reviewing multidigit addition and subtraction in preparation for a chapter test. This coaching conversation is represented in Appendix B as “Debrief 15.” Amy meets to debrief with the classroom teacher to revisit the lesson. The two plan and debrief lessons fairly regularly.

**AMY:** So, what did you think? How did it go?

**Teacher:** I don’t know.

**AMY:** Do you think they got it?

**Teacher:** I think, I get, like we’ve talked about this with the math talk where I could keep going on and on. So, then I feel like we were on that one problem for like a bajillion years and yeah, so, I don’t know. I feel like, sometimes I need to reign it in.

**AMY:** I get caught up in that too, like when I saw that Student One had that other way of solving the problem, he added to, I was noticing that he added instead of subtracting to solve.

**Teacher:** Yeah. And I would’ve loved to spend more time on that so we could clarify, but...

**AMY:** But then it takes so long, so it’s just about balancing the time.

**Teacher:** I also noticed Student Two was like, “I disagree” and I was like excited to hear the math talk moves, and I wanted him to show us, but then we’d already spent like what, fifteen, twenty minutes on that one problem. Instead I told him, “Well you can go talk to Student Three in the back and help him understand this problem.”

In this initial part of the conversation, Amy has an opportunity to capitalize on the focal area of “analyzing student thinking,” or to follow up about the flow of the student discourse during the lesson. Instead, she allows the conversation to shift from brief comments about student to student interaction, rather than using follow up questions and comments to help the teacher dig in and examine what students are saying and doing mathematically and how to adjust the pacing of student led conversation in the moment.

This is perhaps a missed opportunity on the part of the coach to use focused coaching moves to help the

teacher think more deeply about the MTPs and about what it is in her teaching practice (the use of specific MTTs) that can help students express their mathematical reasoning. For example, Amy could have posed a follow up question, such as, “What is it that you would want to clarify, for him or his peers?” as a way to press the teacher think about the possibility of helping students see the inverse nature of adding and subtracting and how students could benefit from exploring the relationship between addition and subtraction strategies further. Alternatively, she could have asked the teacher a follow up question regarding how teachers decide how and when to “reign it [the math talk] in.” Instead, Amy lets the teacher shift away from focusing on a specific instance mathematical thinking or use of math talk moves and the thread of conversation shifts as a result of the lack of follow up probes on the part of the coach.

In the next part of the conversation, Amy moves on to further discussion about mathematical discourse. Again, this is one of the professional learning focal areas and an MTP that a focused series of coaching moves could help the teacher to examine deeply. Rather than discussing what features of the “math talk” (Chapin et al., 2013) led to more or less productive conversation around subtraction algorithms during the lesson, Amy’s questions once again lack focus and depth to help the teacher examine her own practice. Amy begins with a suggestion about planning for a future lesson, then asks the teacher to reflect on what she “noticed” about students’ mathematical work.

**AMY:** I think they’re getting a lot out of the math talk. It’s just trying to figure out how much time to spend on it, and we said math talk is going to be messy. The whole thing is that it’s about quality over quantity. So, maybe what we can plan for next time is to focus on one problem more intensely like that, and have different students share their strategies, but then move on. Because today we went straight to the other problem and I thought they were kind of losing focus. What did you notice about the math that they were doing?

**Teacher:** I think they’re doing okay. I like that when we added that addition problem in, how most of them caught on that it was not a subtraction situation.... although some did subtraction to solve. Before I give the test today, I’ll just have to say, “Make sure you’re looking at what type of problem you’re doing” so they pay attention.

**AMY:** Did you get to see what Student Four did? What did he do on that last problem? I thought that was interesting,

**Teacher:** Oh, where he just took each part one at a time? The ones, the tens and the hundreds and was adding them?

**AMY:** Did he use that strategy on the other problems?

**Teacher:** I didn't notice.

**AMY:** I thought it was good that he was at least making a connection, that he had to look at those place values with the hundreds, tens, and ones and split them apart. So, how do you think the test will go today?

Here the teacher focuses more on the problem content than the strategies students were using and discussing during the lesson. Rather than pressing the teacher further, Amy shifts from trying to engage the teacher in conversation about student strategies and math talk to the upcoming assessment. Interestingly, when I met with Amy after the coaching session and asked about her goals going into the debrief, she said, "My goals, well for myself with her, was just to continue to work on that, not so much the math talk, but the management of making those kinds of decisions, when and where and how much. Let kids explain" (Amy Post Interview Session 15). Although Amy brings up the idea of math talk and student strategies in the debrief, she herself moves the conversation away from this self-reported "goal" to talking about the assessment. Appendix B illustrates how the final part of the conversation appears disconnected from the topics of student thinking and discourse and shifts towards anticipating how students will perform on the test instead.

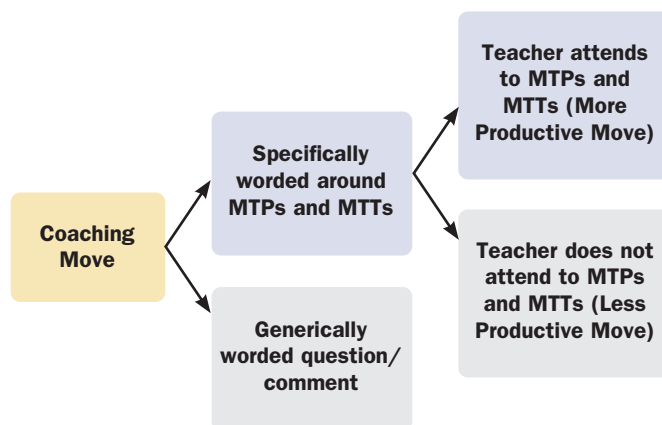
Throughout this coaching conversation, Amy misses multiple openings to press the teacher further to discuss student strategies and mathematical discourse, which results in shifts from topic to topic, with little focus on specific details related to student thinking or math talk/goals. When examining the conversation in terms of productivity, even when Amy uses coaching moves that are worded in ways that focus on one of the three focal areas, the teacher's remarks are often brief and unspecific in nature. Additionally, Amy does not utilize follow up coaching moves (i.e. questions, comments, suggestions) to engage the teacher in deeper reflection or conversation of these topics during the conversation. As a result, the

teacher's attention to specific MTPs and MTTs remains at a shallow, disconnected level of reflection.

This vignette highlights one example from my data that suggests a potential need for mathematics coaches to be conscientious in the ways they help to structure coaching conversations with teachers. When comparing Vignette 1 with other coaching conversations in my study, it became evident that it is helpful for coaches and teachers to know which focal areas they plan to focus on during the session, and that coaches may need to use particular types of coaching moves to help facilitate meaningful conversation (I share an example of this later in the findings). Without focus, conversations with classroom teachers may involve only surface level discussion about MTPs and MTTs, or wander off-topic, which can fail to help teachers learn to attend the focal areas more intentionally in their planning and instruction.

Along with focus, coaches must also be prepared to use a range of follow up coaching moves (such as prompting, probing, and offering examples/suggestions to stimulate additional talk around MTTs) to help teachers learn to attend to the focal areas during these conversations when an initial question or suggestion does not do so (see Figure 5). When coaching moves result in a teacher response not attending to MTPs or MTTs, if the coach does not try again to engage them on a topic, the coach often loses out on an opportunity for productive talk to occur. The next section builds on this idea of knowing how and when to use follow up moves to respond to the direction the teacher and coach take the coaching conversation.

FIGURE 5.  
*The Potential Flow of Coaching Conversations*  
(Adapted from Jakopovic, 2017).



### Unbalanced and Unresponsive Conversations

Even when coaches come in with a focus for the coaching conversation, it is possible for the balance of the conversation to go awry. I categorized 6 of the 47 coaching conversations as “less productive” due to a shift in balance from the teacher to the coach doing the majority of the talking (see Appendix C). In these instances, if focal areas were discussed, the talk was led by the coach, and when teachers picked up on these cues to talk about the mathematics, it was typically for only one turn of the conversation. With the exception of one of these six conversations, teacher responses attended to an MTT that related to the mathematical focal areas approximately 50% of the time, meaning that half of the time teachers responded with generic comments or comments about organization and logistics of the lesson. Another feature of these coaching conversations was the use of a checklist or questioning “script” on the part of the coach to help facilitate the conversations. In my field notes for several of these sessions, I noted the focus of the coach tending to be on the script, rather than using follow up probes and questions to elicit additional ideas and information from the teacher in a conversational way. The literature on instructional coaching suggests that the dialogue between a coach and teacher should be a partnership, and that the coach needs to employ active listening in order to be responsive to the teacher throughout the conversation (Gibbons et al., 2017; Ippolito, 2010). Thus, a second finding of this study is the confirmation that when coaches are unresponsive to teachers’ thinking, or begin to overtake the thread of the conversation, this can also lead to less productive talk by teachers around mathematical focal areas. Part of the goal of this study is to examine what this looks like in practice, which the third vignette will illustrate.

Vignette 2 takes place when Sharon meets to debrief with a 5th grade teacher after observing a lesson where fraction tiles are used to compare mixed numbers. Sharon and the classroom teacher have only met a few times prior to this coaching conversation, and the relationship is still fairly new. Sharon leads off trying to engage the teacher in reflecting on the goal of the lesson.

**SHARON:** So, let’s talk about yesterday’s lesson. You were having students compare mixed numbers using fraction tiles.

**Teacher:** Yes, there was a lot going on in the textbook, so I decided to just focus on having students represent the numbers using the tiles.

In this beginning excerpt, Sharon perhaps misses an opportunity to press the teacher about the intentional use of manipulatives and tie back to MTPs and MTTs related to lesson design and student understanding. Where she could have asked a question such as, “Why did you feel the tiles were the best representation to focus on?” to probe the teacher further, Sharon moves right along in the next series of turns to a new topic.

**SHARON:** It’s so important to make those adjustments to help students be successful in understanding the content. So, something I noticed during the lesson is that you often tried to get students to explain their thinking, and sometimes, in the moment, it can be tricky to come up with just the right questions. You would ask students things like, “How do you know?” or “Why do you think that?” What did you notice about how students responded to these questions?

**Teacher:** Yeah, I think sometimes they have a hard time putting the math into words.

**SHARON:** I could tell it was something you were being really intentional about trying to do during the lesson though, which is great. So, the types of questions you were posing fall into a category of “Encouraging Reflection and Justification Questions,” and can be really nice follow ups to ask after posing an anchor question to get students thinking. And you feel pretty comfortable using those types of justification questions?

**Teacher:** I think they come pretty naturally to me, yeah.

Sharon misses a chance here to help the teacher focus on how these question types can elicit evidence of student thinking, which could have helped the teacher connect these “teacher moves” back to impact on student learning. Without anchoring the practice of questioning back to the lesson itself and the evidence of student thinking the teacher observed during the lesson, it may be unclear to the teacher why Sharon is so focused on questioning.

Prior to the coaching session, Sharon had expressed to me that this was her personal goal for the coaching session, explaining, “I was going to obviously see if there was something she wanted first. I didn’t really hear anything come out [during a scheduling conversation], so I jumped in with the [math] talk” (Sharon, Pre-Interview, Session 2).

Rather than helping the teacher to reflect on what she is already doing to help students who struggle to put “the math into words,” Sharon continues sharing information about question types that she brought with her to the debrief meeting, sticking to her agenda rather than focusing on the aspects of the lesson the teacher appeared interested in discussing. A shift in balance happens at this point, and the coach begins to dominate the remainder of the conversation.

**SHARON:** So, there are other question types as well, ones that might be a little more challenging to think of in the moment, but that are equally important to helping students learn how to explain their reasoning and make connections in math. So, I was thinking that, if you were to use the probing questions you are already good at in conjunction with some of the other question types, it could have a powerful impact on students in your classroom. For example, if I lead off with a question like, “What do you notice about the size of the pieces and the denominator in each of those examples?” and then follow up with probing questions as students explain, it could help them make those mathematical connections that we are aiming for when we use the manipulatives.

**SHARON:** Okay.

Coach: So that question is an example of the type, “Making the Mathematics Visible,” where our goal is to help students see mathematical structures and make connections between the physical representation and the abstract. It might also be that students are not sure what the proper language and terminology is to talk about their thinking, so you could also include questions that help to draw that information out from the group. “What is the top part of a fraction called? The bottom part? What do these parts of the fraction mean?” those sort of questions can help remind students of the vocabulary and concepts that are embedded in this problem.

As the vignette continues beyond these turns, Sharon continues to provide information to the teacher, without providing time for the teacher to process or to connect to examples from her current practice. The teacher’s responses become more brief and non-committal (“Got it,” “Makes sense,” “Okay.”) and it is evident that the focus of the conversation has shifted completely away from the lesson and the teacher’s initial conversation about

manipulative use. As Sharon continues, it is unclear to what extent the information being shared is helpful or being internalized by the teacher because she is no longer engaged in the dialogue.

Vignette 2 provides an example of a small subset of data points in my study where coaching can become unbalanced and unresponsive in nature (Sailors & Price, 2015; Ippolito, 2010). It illustrates the importance of not only utilizing coaching moves that focus around MTPs and MTTs, but also the importance of being responsive to both the goals of the teacher during the conversation, as well as the direction of the conversation itself. Whether it was a lack of noticing on the part of the coach or relying on a list of pre-prepared questions to guide the conversation, when coaches failed to do this, often the conversation became one sided in my data, with the coach doing the majority of the talking. This is not dissimilar to Jackson’s (2018) principles for an effective teaching mindset, which includes starting where students are in their current understanding, as well as the adage that teachers should “never work harder than your students.” Similarly, coaching conversations can be less productive when the coach does all of the work during the conversation and fails to meet teachers where they are in their current understanding of effective teaching practices. If Sharon had abandoned her agenda, and instead probed the teacher to reflect on the intentional decision to use fraction tiles, she could have engaged in a rich discussion about mathematical goals and problem design. This discussion could have helped the teacher begin to develop an intentional noticing of why these decisions are so important to fostering students’ mathematical understanding. Instead, the vignette presents another missed opportunity for a coach to engage in productive conversation about mathematics focal areas with a teacher.

### **Moving Toward Productive Coaching Conversations**

In the first two vignettes, I illustrate examples of coaching conversations where coaches either engage in surface level discussion about MTTs and MTPs or fall into the trap of being more directive than responsive in their coaching. The final finding of my study suggests that coaches who actively listen and are engaged in what classroom teachers are saying (or not saying) can be more responsive in the moment. If coaches utilize coaching moves and follow up moves flexibly and strategically to press teachers to consider their practice in ways that lead to successful incorporation



of the MTPs, this can result in more productive coaching conversations. I categorized 33 of the 47 coaching conversations as being more productive in engaging teachers in dialogue around the three mathematical focal areas. In all of these instances, the coach was able to guide the teacher's focus toward the MTTs and MTPs more successfully, and in nearly all of these instances, coaches used follow up questions and probes to help teachers clarify and extend this thinking. The final vignette illustrates a third finding from my study, which is that when coaches facilitate the use of coaching moves in more productive ways and maintain balance in the conversation, they can help co-construct meaning from these reflections on and in practice with the teacher (Schon, 1983).

In Vignette 3, coach Amy is meeting to debrief a lesson on graphing with a 2nd grade teacher. The two often engage in coaching cycles together, and despite having a brief amount of time to meet, Amy uses a series of coaching moves aimed at helping the teacher reflect.

**AMY:** Alright, so we don't have a lot of time, but what's something that you feel like went really well?

**Teacher:** I'm glad that when the groups finally started working together, they were realizing and kind of picking things out of each other. Like, you would hear one person explain how, then the others would also attempt to explain to me how instead of just sitting back and having one person explain.

**AMY:** Right.

**Teacher:** Because that's happened in the past, so I can tell that they're starting to feel more comfortable and not just with the graphs, but also in using math talk and explaining things to me.

**AMY:** Good. Yeah, I know at one point they were struggling with making the graph, and at one point during the planning session, you had even talked about giving them a graph template. So, how do you feel about that now since you didn't?

**Teacher:** Right. I'm glad I didn't. Especially when we did the second table, because they did get it, and they just needed that little extra time, so I'm really glad that I didn't. They're getting there. So, I'm glad that I didn't. I had them in my hand, remember?

**AMY:** I do.

Amy intentionally poses questions that tie the planning session to the lesson enactment during the initial turns in the conversation, and these coaching moves help the teacher to consider her students' mathematical understanding, one of the three focal areas. The teacher acknowledges the value of allowing students time to engage in "productive struggle," and how she maintained a student-centered focus during the lesson (NCTM, 2014, 2018). Rather than shifting focus after this initial remark from the teacher, Amy continues to press on with follow up probes and questions to help the teacher reflect more deeply about the specific MTTs she used to help the lesson go successfully. She purposefully restates event from the lesson for the teacher to reflect on, and then poses questions to help the teacher connect the outcomes back to specific aspects of planning and teaching tied to the focal areas.

**AMY:** So, what do you think you did, for the groups that were really successful in the end, what moves did you make that led to that success for them? Because it really is tough to make a graph on your own. But what did you do that helped them with that?

**Teacher:** I think when it came to deciding like what to put where or what the interval should be, I just asked them, "Well, what is the reason that you did this?" and had them explain that to me. I think when they were explaining it to me why they were having hard time, for example, "Well, we just have enough room to go to seventeen," and then I explained to them, "Well, how high do you really need to make it?" After that, I didn't have to tell them the answer. They kind of figured that out on their own just by answering those questions.

**AMY:** I actually noticed that throughout the lesson, as you worked with the different tables you were kind of probing and questioning and trying to get them there without taking over their thinking.

**Teacher:** Right.

**AMY:** Is that purposeful on your part that you?

**Teacher:** Yes, I've been trying really hard to do that as a teacher, when they are at a loss for words, without just like flat out telling them, "Okay, do this next."

The remainder of the coaching conversation continues in a similar manner, with Amy probing the teacher about

specific elements of the lesson that draw the sometimes unconscious decisions of the teacher out to the forefront, and by actively listening and responding to the reflections of the classroom teacher to guide the direction of the conversation (Gibbons et al., 2017; Ippolito, 2010; Schulte, 2020).

Vignette 3 provides a counterpoint that illustrates when discussion about mathematics is focused, connected directly to the mathematical focal areas, it can begin to help teachers identify the specific teacher actions that lead to successful mathematics lessons. Amy's purposeful and flexible use of initial and follow up coaching moves in this vignette allow the teacher to begin to notice the aspects of her planning and teaching that led in this instance to productive struggle, high student engagement, student discourse, and the successful implementation of a lesson that meet her mathematical learning goals. By highlighting these MTPs in a reflective coaching conversation, mathematics coaches can help teachers to develop this sort of noticing of the aspects of planning and teaching that will facilitate them in becoming more intentional about the continued incorporation of the MTPs in their future practice.

### *Discussion and Potential Implications*

In this study, I found that the types of coaching moves used by coaches, whether those moves are worded in ways that specifically connect to the three MTP focal areas, and the extent to which coaches are responsive to teachers during coaching conversations can influence the overall “productivity” of the coaching conversation. Conversations where coaches use a range of moves and are explicit in connecting those coaching moves to MTPs and MTTs, often help teachers attend to these features of reform-oriented teaching practices better than those moves that are not. Similarly, when coaches are responsive to the comments of teachers, they are sometimes better able to guide the conversation toward MTPs and MTTs, and help teachers see how to regularly plan with the focal areas in mind in their practice. As we begin to better understand how what coaches say and do during these conversations influences what teachers attend (or fail) to in their practice, we can continue to improve the potential impact of this professional development model.

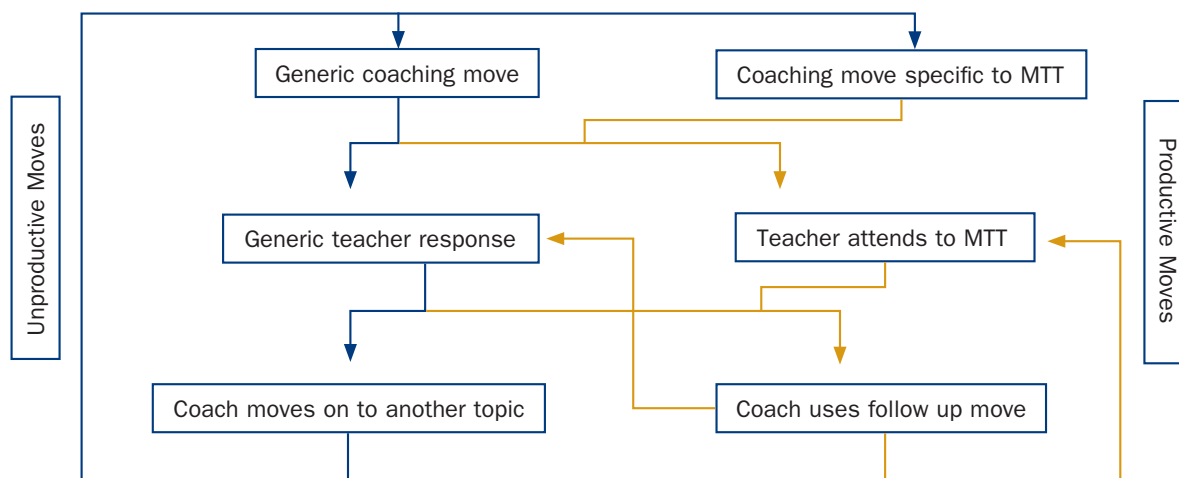
Much in the way that teaching is a complex process (Cochran-Smith & Lytle, 1990), instructional coaching is complex (Ellingson, et al., 2017; Killion & Harrison, 2018; Knapp, 2017). One idea that came out of this study is that, alone, coaching moves may be neither inherently productive or unproductive, it is how they play out within the conversation, and how each of the actors (the coach and the teacher) reacts to these moves, that determines their impact on the conversation direction. Figure 6 illustrates the patterns of coaching moves over the course of a coaching conversation that led to more or less productive talk around the mathematical focal areas in this study. In my larger study (Jakopovic, 2017), I categorized coaching conversations along a range of less to more productive and found that where the conversation goes after the initial coaching move sometimes matters more than the initial coaching move itself. When coaches fail to listen to where the teacher is in their thinking and in the reflection process, they may miss opportunities to engage them productively.

The idea that the moves themselves are not the only determining factor in the success of coaching conversations suggests that coaches may need to develop certain skills that can help them to enact these conversations productively. Coaches must learn to craft coaching moves that highlight the MTPs and MTTs they are trying to help teachers attend to and reflect on. They must also recognize when follow up moves are needed to go beyond surface level conversations and help teachers engage in reflective talk about their teaching practice, as well as to keep the conversation teacher-centered and retain a balanced dialogue.

To do this effectively, coaches must come into the conversation with classroom teachers with specific mathematics and pedagogical goals in mind (Desimone & Pak, 2017; Russell et al., 2017). These goals may be co-constructed with the classroom teacher prior to the coaching conversation or designed by the coach depending on the experience level of the teacher in working with MTTs and MTPs as effective teaching strategies in mathematics (Gibbons et al., 2017). From there, the coach must be prepared to engage teachers in “deep conversations” about mathematics teaching and students’ mathematical ideas (Russell et al., 2017) that are clearly focused around these goals (Desimone & Pak, 2017). As the literature suggests, this requires the planning of carefully phrased questions to ensure the coherence of the dialogue between coach and teacher (Gibbons et al., 2017). It also requires the coach to employ active listening skills to determine whether teachers

FIGURE 6.

*Potential patterns of coaching interactions between coaches and teachers.*



are attending to the mathematics focal areas these questions are tied to or not, so that they may utilize follow up probes and coaching moves to press for deeper talk about ambitious teaching practices and student thinking. For example, in the coaching conversation illustrated by Vignette 3, Amy asks the teacher specifically about her decision to have students create their own graphs without a template, then uses a series of follow up probing questions that allow the teacher reflect on her goal of having students create their own graphs. This facilitates the teacher thinking about the benefits of engaging students in productive struggle, one of the MTPs tied to the focal area “Mathematical Goals” in my framework, and one of her mathematics and pedagogical goals for the lesson.

Researchers and instructional coaching experts alike describe this “responsive coaching” as critically important to promoting active participation on the part of teachers in this work (Campbell et al., 2013; Gibbons et al., 2017; Ippolito, 2010; Knight, 2017). When coaches are responsive, they begin to cycle on the right side of the diagram in Figure 5, as the coach and teacher begin to dig more deeply into an idea through continued focus on one of the mathematical focal areas. This requires preparation and practice on the part of the coach, both in terms of planning for and engaging in focused, coherent, and deep mathematical conversations with teachers. In Vignette 2, when Sharon began directing the conversation, she did not notice that the teacher was no longer actively engaged in co-constructing the conversation. Contrastingly, in Vignette 3 Amy posed follow up questions, such as, “So

what do you think you did...that led to that success for them?” and provided specific examples of her own noticing of teaching moves that fostered productive struggle (e.g. “I actually noticed...you were kind of probing and questioning and trying to get them there without taking over their thinking.”). Engaging in responsive coaching that keeps the teacher actively engaged can help them learn what features of their practice to attend to in order to engage in ambitious mathematics teaching. Coaches can pose follow up questions, offer suggestions, or share their own wonderings about students’ mathematical thinking as opportunities to take the conversation deeper with teachers.

When coaches use productive moves like this to maintain a focus on the MTPs and work toward a balanced, responsive conversation with classroom teachers, they can begin to shift the mindset and focus of classroom teachers about planning and enacting mathematics lessons over time. In their research, Sherin and van Es (2009) found that teachers often focus their attention on a range of lesson elements during the complex act of teaching, such as student behaviors and engagement. In my study, when coaches consistently use focused, productive coaching moves, and maintain a responsive stance in their conversations with teachers, I found they can also help teachers to shift their professional noticing toward the MTPs and reform-oriented teaching practices. Van Es et al. (2017) describe these shifts as helping teachers learn to attend to student thinking and learning in ways that can transcend planning for or reflecting on a single lesson. If a potential goal of coaching is to help

teachers develop a mindset for planning and reflecting in and on practice, rather than treating daily instruction as a series of isolated actions, it is important to better understand the potential impact coaches can have on teacher noticing beyond the scope of the current study.

The findings of this study suggest that the ways in which mathematics coaches engage with teachers during coaching conversations can lead to more or less development of teacher noticing of the aspects of mathematical goal setting, lesson planning, and examining student thinking in ways that can engage them in using reform oriented teaching practices (Ball et al., 2008; NCTM, 2014). In particular, there are specific skills coaches can develop in their practice that may positively affect this work with teachers, including:

- Developing effective skills in fostering two-way communication;
- Developing teachers' professional vision and noticing of reform-oriented teaching practices;
- Developing the coach's own professional vision and noticing of the teacher as a learner;
- Understanding and developing productive patterns of coaching moves and a responsive practice; and
- Developing a range of follow up coaching moves to increase teacher noticing of and use of MTPs.

To help coaches develop these skills and practices, the following suggestions stem from the findings of this study:

- Co-construct a mathematical goal for the lesson and a pedagogical goal for the coaching cycle with the classroom teacher prior to meeting;
- Pre-plan carefully constructed questions that attend to the coaching cycle goals and are coherent;
- Be flexible in the use of these questions and prompts during the conversation to ensure the teacher is an active and engaged participant in the coaching and planning process;
- Employ active listening skills while engaging in conversations with teachers and be prepared to utilize follow up coaching moves to help "deepen" the focus on the mathematics and student thinking;
- Brainstorm possible probes ahead of time to help pivot in the moment during dialogue with teachers;
- Be aware of the balance between being responsive to the needs of the teacher and being directive about

the need to employ ambitious and equitable teaching practices for all mathematics learners;

- And, be consistent in the use of focused coaching moves as a way to help teachers learn what is worth attending to in order to develop ambitious mathematics teaching practices.

Coaches can engage with a number of resources, such as the toolkits provided by McGatha et al. (2018) to assist with goal setting and planning of intentional coaching moves and questions prior to meeting with classroom teachers to help engage in productive conversations that center on the mathematics focal areas defined in this study. By planning and enacting coaching cycles that keep elements of effective coaching practice in mind (Desimone & Pak, 2017), and through deep conversations with classroom teachers (Gibbons et al., 2017), mathematics coaches can help teachers develop noticing of the features of their teaching practice that can engage learners in learning conceptually rich mathematics.

In this study, examining coaching moves used during planning and reflective conversations with teachers helped generate a framework for examining how mathematics coaching moves can be "productive" in engaging teachers around MTPs. In some instances, coaches guided conversations that focused around many layers of reform based teaching practice, including discussion of mathematical goals, designing meaningful problems, and anticipating and analyzing students' mathematical thinking. Productive coaching moves that were found to rely not only on the phrasing and patterns of interactions on the part of the coach, but also those of the classroom teacher.

### *Limitations and Future Directions*

This study was designed as a case study, examining individual instances of coaches having conversations with teachers to plan and reflect around MTPs and MTTs. As such, additional research is needed to further test and develop the definitions and theories presented here. The small sample size of coaches from a single school district, as well as the limited ability to observe coaches working with the same classroom teachers for multiple cycles, are limitations of the current study that should be tested with additional and more robust studies to inform and better shape the arguments presented herein. In particular, the

goal of this study was to develop a framework for examining coaching conversations, however additional research needs to further test the reliability of the framework with larger sample sizes and using diversified participant pools. The boundary of this case study was the planning and debriefing conversations themselves, which presents another limitation of this work. Future research needs to be done that examines the connection between these conversations and the corresponding enacted lessons to see if teacher noticing and reflection translates to instructional practice. Additionally, understanding how coaches make both planned and in the moment decisions when engaging in deep conversations is an aspect of mathematics coaching that needs to be better understood.

Although existing studies have attempted to quantify coaching effectiveness, less work has illustrated what coaches actually say and do to make this happen or not).

This study suggests that the research of Sherin and van Es (2009) of developing the professional noticing of teachers in ways that shift their professional vision toward enacting and reflecting on MTPs in their practice could be worthwhile to further pursue in future studies on mathematics coaching. This enactment of coaching conversations is not unlike the orchestration of productive mathematics conversations with students (Smith & Stein, 2011). Having these sorts of discussions requires planning on the part of the teacher. Similarly, mathematics coaches may need to anticipate and plan purposeful questions to move their conversations with teachers forward as well. By analyzing examples of lived coaching conversations and providing evidence to the mathematics educational community, it is the hope that coaches will have tools and resources to better visualize and enact the elements of effective mathematics coaching practice presented by the professional literature. ♣

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**APPENDIX A**

**Examples of More/Less Productive Coaching Moves Around the Focal Areas**

Mathematical Focal Areas	Examples of Productive Coaching Moves (Based on the Professional Literature)	Examples of Coded Excerpts from the Data of Coach Move & Teacher Response
<p><b>Mathematical Goals</b></p>	<ul style="list-style-type: none"> <li>• Posing questions around mathematical goals</li> <li>• Offering ideas and suggestions around mathematical goals</li> <li>• Prompting use of data/student work analysis to inform mathematical goals</li> </ul>	<p><b>More Productive:</b></p> <p><b>Coach:</b> Specifically, what is your objective for this lesson? When you get done, what do you really want to know?</p> <p><b>Teacher:</b> I want to know if they can look at a ten frame, recognize the numbers and write that number, and then if they know the teen numbers in order. Because I know they know one through ten in order.</p> <p><b>More Productive:</b></p> <p><b>Teacher:</b> I had him do it on the board and he wrote 39 and this box equals 62. And he said, “Well, I was looking and knew 9 plus something couldn’t be 2, so I knew it had to be 12. So I put the 10 up here, and then I knew 9 plus 3 was 12.</p> <p><b>Coach:</b> So what you said, I was just thinking, this seems like a great moment where, how do we get this to transfer to some other kids? ... Do we say something like, ‘Can someone explain to me again how he did this?’</p> <p><b>Teacher:</b> Like have someone else explain it? I like that because I keep telling the class to pay attention, We’re learning from our friends right now. Watch all the different ways to solve these problems.” ...but like everyone is just sitting there waiting.</p> <p><b>Coach:</b> I think this is such a big moment, you need to spread it.</p> <p><b>Teacher:</b> Yeah, I think that if someone else explains it, it will help me check for comprehension too.</p> <p><b>Less Productive:</b></p> <p><b>Coach:</b> I know we didn’t get as far as we wanted...with show me ten more, ten less...I mean there were some that obviously were stumped but then it was good that they all seemed [eventually] to catch on.</p> <p><b>Teacher:</b> So yeah, I thought that was good. Overall I thought it was alright.</p> <p><b>Less Productive:</b></p> <p><b>Coach:</b> So, my first question is, how do you think it went with them coming up to [describe] the circle and with the [descriptive] writing?</p> <p><b>Teacher:</b> I think that the circle thing was fine. I think maybe in retrospect maybe just choosing just a couple and then having the rest... they all wanted to go reach and touch it [the circular objects]...</p> <p><b>Coach follow up:</b> I was pleasantly surprised with the writing though.</p> <p><b>Teacher:</b> Mm hmm. They did pretty good with that. The ones that I figured would be able to handle it, handled it really well. And the other ones were trying to copy, which isn’t out of the ordinary for any of our writing.</p> <p><b>Coach:</b> For kindergarten. And that’s why I purposefully wrote two of them up there because I knew some of them weren’t going to be able to do it.</p> <p><b>Teacher:</b> Right.</p>

Mathematical Focal Areas	Examples of Productive Coaching Moves (Based on the Professional Literature)	Examples of Coded Excerpts from the Data of Coach Move & Teacher Response
<p><b>Mathematical Problem Design</b></p>	<ul style="list-style-type: none"> <li>• Posing questions around mathematical problem design</li> <li>• Offering ideas and suggestions around mathematical problem design</li> <li>• Prompting use of data/student work analysis to inform problem design</li> </ul>	<p><b>More Productive:</b></p> <p><b>Coach:</b> So what are you thinking of doing...have you already looked at it and decided which activities you feel are most beneficial?</p> <p><b>Teacher:</b> What I would really like to do, I know it gives the whole template here, but what I'd really like to do is have the kids kind of create their own.</p> <p><b>More Productive:</b></p> <p><b>Coach:</b> Alright. So talk me through, what are your thoughts for tomorrow on line graphs?</p> <p><b>Teacher:</b> With line graphs, talking, just kind of starting off showing them this, um, this table of data. And then talking about what patterns they notice and what this could possibly be a table for and so building that knowledge of why we have, why we would take this table. I mean is this something that we will be talking, what would that even be for? And then extending down to line graphs, and then talking about scales and intervals... we're going to make a quick diagram of what scales are, of what intervals are, and then just going into this section talking about how we can relate them to ordered pairs. And a big piece that I want to talk about is this, the break in the scale. Because that's something that's, I think a lot of students might not key into if not explicitly mentioned.</p> <p><b>Coach follow up:</b> Okay so that was another question I was going to ask. Any other misconceptions that students might have here other than that disruption of the scale? Anything else that you're...?</p> <p><b>Teacher:</b> Well something, and this is, it's not the same interval both ways. I mean this, we're going up by two every time and this I'm going by one in time and it's, I think that's something that they're really going to have just some struggles with is knowing which one I plot on my x-axis and which one I plot on my y-axis.</p> <p><b>Coach follow up:</b> But, would this be an opportunity then to talk to them about, as long as you keep this on the x or y-axis, it would be okay...</p> <p><b>Less Productive:</b></p> <p><b>Coach:</b> You talked about baskets...so at each basket would there be the same objects? ...So everyone in that group is measuring the same object?</p> <p><b>Teacher:</b> I was thinking of different objects in each basket, but what do you think? ...I mean, what would be the best organized, easy management piece for the kids?</p> <p><b>Less Productive:</b></p> <p><b>Coach:</b> So you had a lot of the questions that really um, built the background, reviewed the vocabulary, those kind of things. What, what questions did you feel really got at the mathematics, I guess?</p> <p><b>Teacher:</b> Um, when they were figuring out how to label it, I guess. One person knew you had to start at zero fourths, and then I think that's when everyone was like, "Oh yeah!" [Coach moves on to another topic]</p>

Mathematical Focal Areas	Examples of Productive Coaching Moves (Based on the Professional Literature)	Examples of Coded Excerpts from the Data of Coach Move & Teacher Response
<p><b>Examining Student Mathematical Knowledge and Ideas</b></p>	<ul style="list-style-type: none"> <li>• Posing questions around students' mathematical knowledge or ideas</li> <li>• Offering ideas and suggestions around students' mathematical knowledge or ideas</li> <li>• Prompting use of data/student work to analyze students' mathematical knowledge or ideas</li> </ul>	<p><b>More Productive:</b>  <b>Coach:</b> "How might did it grow?" That was the question they came up with and they...counted every inch and said it grew 17 inches because they weren't thinking of it as linear growth. Did you notice?  <b>Teacher:</b> I thought about that during the lesson too, because you're exactly right. What we've done so far with graphs has been...things you can just add up.</p> <p><b>More Productive:</b>  <b>Coach:</b> So what if we start out by just saying a question of, how much paint do you think you're going to have?  <b>Teacher:</b> Well almost two ounces, because four-fifths is close to another one whole.  <b>Coach follow up:</b> Mm hmm. So two and two, about four. So do you think your kids, some of your students will come to that idea? If you just ask the question?  <b>Teacher:</b> Yes. I think a couple of my really high students will, but I don't think a lot of them. I think if I say it, well four-fifths, is that going to be closer to zero or to another whole? I think a lot of them will be able to say oh well if I shade it, it's almost another whole. I don't know. Maybe they would get that.</p> <p><b>Less Productive:</b>  <b>Coach:</b> So do you think your average kid knows if...they have an answer that's reasonable, that makes sense or not?  <b>Teacher:</b> No. I'd say no.</p> <p><b>Less Productive:</b>  <b>Coach:</b> As you reflect [on the lesson], what surprised you?  <b>Teacher:</b> One of the things that surprised me was when I saw some of the kids take their fingers and mimic the tile size to estimate without actually measuring first – to mimic the size of the tile as a way of measuring. Also, I was pleasantly surprised that the estimates for the most part were very reasonable.  <b>Coach follow up:</b> What do you think came easily for the students and what was mathematically difficult and why? [disconnected probe]  <b>Teacher:</b> Easily, I think was measuring it with the tiles. They did a great job putting them bumper to bumper. What was hard is they wanted to jump ahead without estimating. I had to step in and strongly encourage the students to estimate before measuring. I need to do a reteach lesson on estimating. There were some who were stressed about being wrong, I had to give them a pep talk to estimate.</p>

Mathematical Focal Areas	Examples of Productive Coaching Moves (Based on the Professional Literature)	Examples of Coded Excerpts from the Data of Coach Move & Teacher Response
<p><b>Setting Pedagogical Coaching Goals</b></p>	<ul style="list-style-type: none"> <li>• Posing questions around students' mathematical knowledge or ideas</li> <li>• Offering ideas and suggestions around students' mathematical knowledge or ideas</li> <li>• Prompting use of data/ student work to analyze students' mathematical knowledge or ideas</li> </ul>	<p><b>Coach:</b> What would you think about, how would you think about if we added an objective kind of just for you?</p> <p><b>Teacher:</b> Sure.</p> <p><b>Coach:</b> Not really for the kids. So find, the objective for the kids is you know, vocabulary and introducing all that stuff, but probably an objective for you would be looking at this as, "Hey this is where my kids are, this is a formative assessment, and these are some things..." And I can sit with you after they're done.</p> <p><b>Teacher:</b> Yeah, I think that's what I need help with, because I can see the answers, I can see they missed so many problems but knowing what to do with them as a class. Like individually it's a little easier, but it's okay, my whole class did...what are my? What am I going to do because of that?</p>

**APPENDIX B**  
**Unfocused/Surface Level Coaching Conversations**

Coaching Session	Coach Moves & Teacher Responses	M 1	M 2	M 3	M4	M 5	M 6	M 7	Moves/ Responses Phrased around Focal Areas
Planning 14	Coach Move <sup>a</sup>	Q	RMG	Q	SPD	SPS	QPS	QAS	5/7
	Teacher Response <sup>b</sup>	PI	PI	SR	SR/G	G	OL	CD	4/7
Debrief 14	Coach Move	QPD+	QES	QPD	QES	QAS			5/5
	Teacher Response	PI, EE	EE	G	CD	—			3/5
Planning 15	Coach Move	Q	QAS	RG	QAS	SPS, I			2/5
	Teacher Response	B b bG	EC, T	G	G	SC/G			1/5
Debrief 15	Coach Move	Q	I	QAS	SES	SPS	SPS		2/6
	Teacher Response	G	—	G	G	EC	G		1/6
Planning 9	Coach Move	QBS	Q	QMG	SPD+	QPD			4/5
	Teacher Response	G	PI	FE-	G	G			2/5
Debrief 9	Coach Move	RMG	SET	SPD	SET				2/4
	Teacher Response	SR	SC/G	PI /G	T				1/4
Planning 8	Coach Move	QG	SPD	QPS	I				2/4
	Teacher Response	AQ	AQ	PI/G	T				2/4
Planning 4	Coach Move	QPD	QG	SPS	QPS				3/4
	Teacher Response	OL	UN	OL	OL				0/4

<sup>a</sup> Coaching Moves: I = Interruptions; Q = Generic questions; QAS = Questions to anticipate student thinking; QBS = Questions about student background knowledge; QES = Questions about examples of student thinking; QG = Questions about teaching goals; RG= Restating teaching goals; QMG = Questions about mathematical goals; QPD = Questions about problem design; QPS = Questions about organization and set up; RMG = Restating mathematical goals; SES = Sharing examples of student thinking; SET = Sharing examples of teaching moves/collected data; SPD = Suggestions about problem design; SPS = Suggestions about organization and set up

<sup>b</sup> Teacher Responses: AQ = Productive mathematical questions; CD = Choosing and developing definitions; EC = Evaluating the plausibility of students' claims; SC= Anticipating student claims; EE = Giving/evaluating mathematical explanations; FE = Finding examples to make a mathematical point; G = Generic comments; LR = Linking representations to underlying ideas/representations; OL = Considering organization and logistics; PI = Presenting mathematical ideas; SR = Selecting representations for particular purposes; T = Tangents; UN = Using/critiquing mathematical notation and language

Note : + Includes follow up question or example from coach

**APPENDIX C**  
**Unbalanced/Non-Responsive Coaching Conversations**

Coaching Session	Coach Moves & Teacher Responses	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	Moves/ Responses Phrased around Focal Areas
Planning 7	Coach Move <sup>a</sup>	QBS	QBS+	Q	SMG SPD+	QPS	RMG	SPD	SPD	SPD	7/9
	Teacher Response <sup>b</sup>	SC, PI	SC	OL	G	PI	LR	AQ	PI, OL	OL	5/9
Debrief 7	Coach Move	SES	QPS	QPD	SET	I	SET	SES	QES	QMG	8/8
	Teacher Response	G	OL	SC	LR		AQ	SC	SC	LR	6/8
Debrief 10	Coach Move	QES	QMG	QAS+	QES+	QPD+	Q	QBS	QES		7/8
	Teacher Response	EE	G	SC	LR	G	OL	G, PI	SC		4/8
Planning 18	Coach Move	QMG	Q	QAS	QBS	QAS	QPS				5/6
	Teacher Response	SR, PI	OL	G	LR	SC	OL				3/6
Debrief 18	Coach Move	Q	RMG	QMG+	QPD	SES	Q	SPD+	SES		6/8
	Teacher Response	SC	SC	G	PI	PI	CD	G	G		4/8
Planning 19	Coach Move	QBS	QAS	QPS	QPS	SPD	QPS	QAS	I	QPD	8/8
	Teacher Response	CT, RR	SC	EE	AA, OL	G	OL	G	—	UN	3/8

Note: See Appendix B for key

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