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Identifying Coaching Practices Implicated in Designing Teacher Learning Opportunities

Abstract

Many districts are using content-focused coaching as a strategy to provide job-embedded support to teachers. However, the current coaching literature provides little guidance on what coaches need to know and be able to do to engage teachers in activities that will support their development of ambitious instructional practices. Furthermore, little is known about how and why effective coaches choose to design particular types of activities with certain teachers. In this article, we report an exploratory case study that examined a mathematics coach who consistently engaged teachers in coaching activities that had the potential to support their development when she worked with them one-on-one in their classrooms. In presenting an analysis of the coach's design of coaching activities, we describe five aspects of her planning practice and delineate the knowledge implicated in those practices. The findings clarify goals for coaches' professional learning, and therefore have implications for school and district coaching policies.

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Many district reform initiatives include content-focused coaching as a primary form of job-embedded professional development, enabling teachers to work with a colleague who has already developed high-quality instructional practices (Coburn & Russell, 2008; Darling-Hammond, Wei, Andree, Richardson & Orphanos, 2009; Neufeld & Roper, 2003; Poglinco et al, 2003; West & Staub, 2003). A growing body of evidence indicates that teachers' engagement with colleagues who are more accomplished can support their development of ambitious instructional practices (Coburn & Russell, 2008; Elmore, 1996; Frank, Zhao, & Borman, 2004; Louis, Marks, & Kruse, 1996; Newmann, King, & Young, 2000; Penuel, Riel, Krause & Frank, 2009). Ideally, content-focused coaches scaffold teachers' development of high-quality instructional practices in a particular disciplinary area by engaging them in activities that focus on key disciplinary ideas, how students learn those ideas, and pedagogical principles for supporting students' learning (Coburn & Russell, 2008). However, very few studies have examined what coaches should do and what they need to know to support teachers' learning. In this analysis, we examine one aspect of coaches' work: the design of activities in which to engage teachers when working with them one-on-one in their classrooms. We report an exploratory case study that focused on how a middle-school mathematics coach who consistently engaged teachers in activities that were likely to support their development of ambitious instructional practices. In our findings, we describe five aspects of coach planning practices and delineate the knowledge implicated in those practices. We hypothesize that the identified practices have implications for content-focused coaching that aims to support teachers' development of ambitious instructional practices at other grade levels and in other disciplines.

Ambitious Instruction

Because we are concerned with coaching that supports teachers' development of ambitious instructional practices, we delineate an empirically grounded vision of high-quality instruction that constitutes the goal for teachers' learning. Decisions about what counts as high-quality teaching must be justified in relation to goals for student learning (Hiebert & Grouws, 2007). Over the past two decades, a number of prominent professional organizations have proposed ambitious goals for student learning across the disciplines of mathematics, science, and English language arts (e.g., National Council of Teachers of Mathematics [NCTM], 1989, 2000; National Governor's Association Center for Best Practices [NGACBP] & Common Core State Standards [CCSSO], 2010; Next Generation Science Standards Lead States [NGSS], 2013).

In mathematics, these goals for students' learning emphasize both conceptual understanding and procedural fluency in a range of mathematical domains, using multiple representations, making mathematical arguments to communicate mathematical ideas effectively, and developing productive dispositions towards mathematics (Kilpatrick, Swafford & Findell, 2001; NCTM, 2000; U.S. Department of Education, 2008). These goals are demanding and have implications for appropriate forms of instruction that are justified in terms of student learning opportunities (Kazemi, Franke, Lampert, 2009). The resulting view of high-quality instruction has been referred to as "ambitious teaching" (Lampert & Graziani, 2009, p. 492).

Ambitious teaching requires teachers to build on students' reasoning as they solve challenging tasks and holding them accountable to learning goals (Kazemi et al., 2009). Recent research in mathematics, science, and literacy has begun to delineate a set of instructional practices that support students' achievement of ambitious learning goals (Franke, Kazemi & Battey, 2007; NCTM, 2000; NGSS, 2013; National Reading Panel [NRP], 2000). In mathematics education, these instructional practices include launching challenging tasks so that all students

can engage substantially without reducing the cognitive demand of those tasks (Jackson, Garrison, Wilson, Gibbons, & Shahan, 2013; Stein, Smith, Henningsen, & Silver, 2000), monitoring the range of solutions that students produce as they work on tasks individually or in small groups (Horn, 2012; Lampert, 2001), and building on these solutions during a concluding whole-class discussion by pressing students to justify their reasoning and to make connections between their own and others' solutions (Chapin, O'Connor, & Anderson, 2003; Smith, Bill, & Hughes, 2008; Staples, 2007; Stein, et al., 2000).

These instructional practices differ significantly from the current practices of most U.S. teachers, and require that teachers reorganize rather than merely adjust or elaborate their current practices (Snow-Renner & Lauer, 2005). Teachers' development of these instructional practices often requires significant learning that involves revising deeply held beliefs, knowledge, and routines (Stein, Smith, & Silver, 1999; Thompson & Zeuli, 1999). Substantial support is therefore required, and content-focused coaching has become an increasingly common way of providing such support. In the next section, we examine the types of coaching activities that have the potential to support teachers' development of ambitious instructional practices.

Content-Focused Coaching

While there are many forms of coaching, we are concerned here with content-focused coaching, where coaches (a) are more knowledgeable partners who have developed relatively accomplished instructional practices (Neufeld & Roper, 2003; Poglinco, et al., 2003; West & Staub, 2003) and (b) aim to support teachers' development of ambitious instructional practices in a particular discipline. Prior studies examining content-focused coaching have analyzed the conditions under which content-focused coaching can support teachers' learning (cf. Coburn & Russell, 2008; Gibbons, Garrison, & Cobb, 2011; Mangin, 2007; Matsumura, Sartoris, Bickel, &

Garnier, 2009). Prior research has also investigated whether content-focused coaching supports teachers' development of specific instructional strategies (Campbell & Malkus, 2011; Cantrell & Hughes, 2008; Matsumura, Garnier, & Resnick, 2010; Ross, 1992; Sailors & Price, 2010; Van Keer & Verhaeghe, 2005). However, the findings of both sets of studies are mixed. A primary reason might be that the amount of coaching that teachers receive and the types of coaching activities in which they engage frequently vary significantly across schools (Bean, Draper, Hall, Vandermolen, & Zigmond 2010; Coburn & Russell, 2008; Matsumura, Sartoris, Bickel, & Garnier, 2009; Rainville & Jones, 2008). As a consequence, unanswered questions remain about what coaches need to know and be able to do to support teachers' development of ambitious instructional practices.

Potentially Productive Coaching Activities

The goal of the analysis that we report here was to understand how content-focused coaches can design coaching activities that have the potential to support teachers' development of ambitious instructional practices. In order to develop criteria for selecting an appropriate case in which to investigate this issue, we first examined the existing coaching literature in an attempt to identify the types of coaching activities that have the potential to support teachers' development of ambitious instructional practices. There is evidence that coaches' initial aim when they begin working in a school is frequently to build trust and cultivate productive relationships with teachers (Killion, 2008). Therefore, they may act to increase their perceived value to teachers by engaging in the following activities: providing resources, testing students, finding websites for student use, or sharing professional publications (Bean, et al., 2010; Killion, 2008). Although such activities have value in forging relationships, they are unlikely to engender rich conversations about central aspects of instruction.

A number of studies have examined how coaches work with teachers (e.g., modeling instruction, or observing teachers' instruction and providing feedback) (Bean et al., 2010; Deussen, Coskie, & Robinson, 2007; Neufeld & Roper, 2003; Poglinco et al., 2003). However we found that these studies rarely justify particular types of coaching activities in terms of the learning opportunities provided to teachers. In a prior analysis, we therefore reviewed the teacher learning and professional development literatures to identify potentially productive activities in which coaches might engage teachers to support their development of ambitious instructional practices (Gibbons & Cobb, in press). These literatures are relevant to coaching because a significant number of these studies examined a more knowledgeable other working with teachers to support their development of ambitious instructional practices. In this prior analysis, we used characteristics of effective professional development as analytic criteria for identifying potentially productive coaching activities. We then reviewed studies in which the analysis included a description of the professional development activities and specified what teachers had the opportunity to learn as they engaged in the activities. We identified three potentially productive activities that coaches might enact one-on-one with teachers in their classrooms: (a) co-teaching, (b) modeling, and (c) debriefing the challenges of implementation. We discuss each in turn in the following section.

In co-teaching, the coach partners with a teacher in an authentic instructional situation (Roth & McRobbie, 1999). Eick and colleagues examined how co-teaching with an experienced teacher influenced the knowledge and instructional practices of ten novice secondary science teachers over an eight-week period (Eick & Dias, 2005; Eick, Ware, & Williams, 2003). They found that the mentor's co-teaching interventions and the in-depth verbal and written feedback provided after the lesson scaffolded the novice teachers' understanding of how to support student

learning. Co-teaching is a potentially productive activity because it enables coaches to influence teachers' instructional practices by making moves that influence the course of the lesson and by providing suggestions teachers can act on during the lesson (West & Cameron, 2013).

There is evidence that observing a more accomplished colleague while particular instructional practices are modeled can also be productive. One of the benefits of modeling instruction in teachers' own classrooms is that it allows teachers to see the type of disciplinary thinking their own students are capable of enacting. Several studies have examined teacher educators modeling aspects of ambitious instruction for preservice and novice teachers (e.g., Bronkhorst, Meijer, Koster, & Vermunt, 2011; Loughran & Berry, 2005; Lundenberg, Korthagen, & Swennen, 2007). For example, Feiman-Nemser (2001) examined how an accomplished teacher's mentoring practices, including modeling, supported eight novice elementary teachers in a two-year induction program. The mentor hoped that by modeling instruction he could support the novices in beginning to identify characteristics of good teaching. To cultivate the teachers' awareness of his choices, he often paused during the lesson to highlight key aspects of his instructional practice and to explain what he was doing and why. After the lesson, the mentor asked the beginning teachers to interpret what they saw. Unfortunately, Feiman-Nemser did not ask the beginning teachers what they learned from observing the mentor teacher. Nonetheless, the findings suggest that modeling might be a potentially productive as it can support teachers' development of an image of accomplished enactment of particular instructional practices (Feiman-Nemser, 2001; West & Staub, 2003). Therefore, it might be a particularly appropriate coaching activity for teachers who are beginning to develop a specific instructional practice.

The third potentially productive coaching activity that we identified is classroom observation followed by a debriefing conversation about the challenges of implementation. Typically, in this activity coaches observe and take notes on how aspects of the lesson are playing out. Sociocultural learning theorists describe learning as a process of moving from assisted performance to unassisted performance (Brown, Stein, & Forman, 1996; Lave & Wenger, 1991; Tharp & Gallimore, 1988). Observing and debriefing appears to be productive in supporting this transition as coaches can engage teachers in post-observation dialogues in which they discuss issues that impact students' learning and together generate solutions to problems of teaching practice (Roth & Tobin, 2001; Scantlebury, Gallo-Fox, & Wassell, 2008). In general, the professional development and teacher education literature indicates that observation and debriefing with a more knowledgeable other can support teachers in improving their enactment of particular instructional practices (Garet, Porter, Desimone, Biram, & Yoon, 2001; Grossman et al., 2009; Putnam & Borko, 2000).

Identifying Coach Planning Practices

In the remainder of this article, we report an analysis of the planning practices of a middle-grades mathematics coach who consistently engaged teachers in potentially productive types of activities when she worked with them one-on-one in their classrooms. We use the term *coach planning practices* to refer to the coach's actions in designing activities in which to engage particular teachers (cf. Lampert, 2009). Our goal in conducting this analysis was to identify specialized coach planning practices that underpin relatively accomplished coaching. Although the analysis focuses on supporting mathematics teachers, we contend that the findings have implications for content-focused coaching in other subject matter areas when the goal is to support teachers' development of ambitious instructional practices.

Methods

The case study we report examined a mathematics coach's work with seven middle-grades mathematics teachers over a four-year period. The data for this analysis came from a larger study that investigated what it takes to support mathematics teachers' development of ambitious and equitable instructional practices on a large scale (Cobb & Jackson, 2011). We first provide background information on the collaborating school district and then describe the selection of the focal coach before detailing the methods we used to document and analyze the coach's planning practices.

Background: The Collaborating District

The focal coach was a middle-school mathematics coach in a large urban district (District B) and worked with grade 6-8 teachers. During the 2007-2008 school year, District B implemented *Connected Mathematics Project* 2 (CMP2), an inquiry-oriented curriculum for middle-school mathematics with ambitious goals for students' learning. The district began implementing a school-based, content-focused coaching design during the prior year to support teachers in using this curriculum effectively. In this design, a mathematics coach in each middle school taught for half the school day and coached during the other half. One of the primary goals for the coaches' work described by district leaders was to provide one-on-one instructional support to their colleagues in their classrooms. The district contracted with the curriculum publisher to provide sustained professional development for the teachers who were selected to become coaches. The intent of this professional development was to support the coaches in developing both an overview of the curriculum and an understanding of what a high-quality implementation looks like. District leaders also provided the coaches with training on how to engage in instructional conversations with teachers, including asking questions that are designed

to help teachers reflect on their instructional practices. The coaches were also encouraged to seek advice from the district mathematics specialists whenever questions related to the curriculum or teacher support arose.

Participating Schools

The research team that conducted the larger study consulted with District B leaders to select a sample of seven middle schools that was representative of district schools in their capacity for instructional improvement. The participants in each school comprised approximately five randomly selected mathematics teachers, the principal, the assistant principal responsible for monitoring mathematics instruction, and the school-based mathematics coach. The initial analysis conducted to select the focal coach drew on interviews with teachers and coaches across the seven schools.

Data for Case Selection

We drew on audio-recordings of the interviews conducted with the seven coaches and the 28 participating mathematics teachers in the second year of the study[i] to determine which of the coaches engaged teachers in potentially productive coaching activities (Gibbons & Cobb, in press). The coach interviews lasted approximately 60 minutes and the teacher interviews approximately 45 minutes. One purpose of the coach interviews was to document the types of activities in which coaches engaged teachers when working with them individually in their classrooms. In addition to describing general types of activities, coaches were asked to provide recent examples of specific activities in which they had engaged teachers. In the teacher interviews, we asked teachers about the types of activities in which they had engaged with their coach, and about what they had learned as a result. Additionally, we asked teachers to describe their interactions with the coach during a recent activity. It is important to note that these

interview data do not allow us to document how the activities were enacted. Although the teachers' accounts of what they learned as a result of engaging in the activities give us some insight into the quality of the enactments, we cannot make claims about the coaches' effectiveness because we cannot directly assess the learning opportunities that arose for teachers.

Analysis for Case Selection

The first author used NVIVO software to code transcripts of the interviews conducted with the seven coaches and 28 teachers for the types of activities in which each of the coaches engaged individual teachers. We coded for co-teaching, modeling, observing instruction and debriefing challenges of implementation, as well as for additional activities such as providing resources, being an extra set of hands in classroom, tutoring or testing students, and sharing resources (e.g., manipulatives, websites for students, or professional publications). The coding process was open so that additional types of activities could be added based on participants' responses.

To assess how each coach was supporting teachers, we developed analytic memos for each school where we recorded the types of activities in which the coach engaged each teacher, how frequently they engaged in each type of activity, the focus of their interactions, and the extent to which the activities were likely to support the development of ambitious teaching practices. In writing these memos, we triangulated the teachers' and the coaches' accounts of the activities to ensure that we did not privilege any one participant's account. For each school, we noted when the coach's and the teacher's account of the activities in which each engaged were consistent. When a teacher but not the coach mentioned a coaching activity, we looked to see if other teachers mentioned engaging in the same activity with the coach. If other teachers reported engaging in similar activities, we inferred that the coach enacted this type of activity with

teachers. If an activity was mentioned by only one teacher or by only the coach within a school, we did not take this activity into account when selecting cases. We did not find any conflicts in the activities reported by the coaches and teachers.

Case Selection Findings

We found considerable variation in the extent to which the seven coaches worked with teachers and in the types of activities in which they engaged. This finding is consistent with prior studies that reported significant variation in the implementation of coaching designs (Coburn & Russell, 2008; Matsumura, et al., 2009). Three of the coaches did not work consistently with individual teachers. One of these coaches was recruited by her principal to teach full-time, a second was repeatedly absent due to poor health, and the third was new to the school and reported that she had yet to establish relationships with teachers that would enable her to work with them productively. Two of the remaining four coaches worked primarily with groups of teachers during department and grade-level meetings, rather than with individual teachers. We note in passing that the activities in which teachers engaged during these meetings did not include the types of activities we had previously identified as potentially productive in supporting the development of ambitious instructional practices (Gibbons & Cobb, in press).

A sixth coach worked routinely with teachers in their classrooms but focused primarily on classroom management. She explained that all the mathematics teachers at her school were in their first year of teaching and needed this type of support before they could move on to more substantial conversations about key aspects of ambitious mathematics instruction, such as questioning techniques. Although classroom management is an important aspect of effective teaching, in our assessment, an almost exclusive emphasis on this aspect of instruction is unlikely to support teachers' development of ambitious instructional practices.

The final coach, Alice (a pseudonym), worked regularly with individual teachers in their classrooms and routinely engaged them in activities that we had previously determined had the potential to support teachers' development of ambitious instructional practices: co-teaching, modeling, observing and debriefing. We therefore selected Alice as the focal teacher for our study. Because the available data do not allow us to document how she enacted the activities with teachers, we do not claim that she was an exemplary coach. However, investigating how she designed the activities in which she engaged teachers does enable us to identify productive coach planning practices.

Prior to becoming a part-time coach in the 2006-2007 school year, Alice had taught middle-school mathematics for 10 years at the same school where she was assigned to coach. For the first three years of the study, Alice taught eighth grade half-time and coached half-time. In the fourth year of the study, when external funds became available, she became a full-time coach. The middle school served approximately 500 grade 6-8 students[ii]. Approximately 95% of students were Latino, 20% were classified as English Language Learners, 10% received special education services, and 95% received free or reduced-price lunch. Seven mathematics teachers participated in the study over four years, 5 of whom participated in the larger study for 4 consecutive years. Their teaching experience ranged from 2 to 12 years with an average of 5.6 years (calculated during the second year of the larger study). None of the 7 mathematics teachers had a degree in mathematics, and none had more than 12 credit hours of mathematics and/or mathematics methods courses.

Data for the Analysis of the Focal Coach's Knowledge and Practices

We analyzed 20 transcribed interviews conducted with the participating teachers each January for 4 years (2008-2011; approximately 45 minutes in length), and 4 audio-recorded

interviews conducted with the coach each January for 4 years (2008-2011; approximately 60 minutes in length) to solidify our understanding of the types of activities in which the coach engaged individual teachers and the teachers' assessments of what they learned as a result. We assessed the coach's expertise as a mathematics teacher by drawing on video-recordings of two lessons she taught during the second and third years of the larger study.

In addition, we assessed her vision of high-quality mathematics instruction that oriented the coach's design of activities in which to engage teachers by asking:

> If you were asked to go into a teacher's classroom for one or more lessons, what would you look for to see if the instruction was of high quality? What would the teacher be doing? Please describe what classroom discussion would look and sound like if instruction were of high quality.

We also assessed her view of the mathematical capabilities of students in the school by asking about what the important challenges are of teaching mathematics at her school and whether she considered the inquiry-oriented curriculum to be appropriate for all students.

In December 2011 and in March 2012 (Year 5, after the completion of the larger study), we conducted two additional follow-up interviews with the coach, each lasting approximately 30 minutes. We asked her to describe and give examples of her goals for teachers' learning, whether she worked with all teachers in the same way, and how she made decisions about how to work with particular teachers. When she mentioned specific coaching activities, we asked her to elaborate on what she believed teachers would learn as a result of engaging in the activity.

Analysis of the Focal Coach's Knowledge and Practices

The first author coded the annual teacher interviews (20 total, across years 1-4 of the study) and the annual coach interviews (4 total). While coding, we further clarified the extent to

which the focal coach engaged teachers in potentially productive activities across the four years of the study, and whether the types of activities changed during these four years. We amended the previous analytic memo (used in selecting the case) and recorded additional activities in which the coach and teachers engaged, and the potential of the activities to support the teachers' development.

To assess the focal coach's expertise as a mathematics teacher, we relied on video-recordings of four mathematics lessons conducted in years 2 and 3 that were coded as part of the larger study using an instrument consistent with ambitious instruction, the *Instructional Quality Assessment* (IQA) (Boston, 2012). The IQA comprises eight rubrics that assess the cognitive demand of the instructional tasks selected for the lesson, the extent to which the level of cognitive demand is maintained through successive phases of a lesson, and the overall quality of classroom discourse (Stein, et al., 2000). Coders were trained to use the rubrics and achieved 80% reliability before they were allowed to code. Ongoing coding reliability was assessed by double-coding 20% of the video-recorded lessons.

The transcripts of the additional two interviews conducted with the coach in year 5 were analyzed to document: (a) the coach's vision of high-quality mathematics instruction (coded using the rubrics developed by Munter (2014) for assessing the sophistication of teachers' and others' instructional visions), (b) the coach's goals for the teachers' learning, and (c) the coach's understanding of how particular types of activities might support the teachers' development. The coding process was open to allow for additional insights into the coach's practices.

Findings

In the course of the analysis, we identified five aspects of the focal coach's planning practices that were implicated in her design of coaching activities: (a) identifying long-term

goals for teachers' development, (b) assessing teachers' current instructional practices. (c) locating teachers' current instructional practices on general trajectories of teachers' development (d) identifying next steps for teachers' development, and (e) designing activities to support teachers' learning. We also identified two aspects of coaching knowledge inherent in carrying out these planning practices: (a) knowledge of ambitious mathematics instruction and (b) knowledge of general trajectories of teacher's development of ambitious instructional practices. We first examine her classroom instructional practices because, as mentioned previously, there is broad agreement that content-focused coaches should be relatively accomplished teachers. We then look beyond her classroom instructional practice and examine the five aspects of her coaching practice that are implicated in her design of activities in which to engage individual teachers.

Classroom Instructional Practices

The IQA scores for the four video-recorded lessons that Alice conducted indicate that she had developed relatively sophisticated inquiry-oriented instructional practices (see Table 1 for a compilation of scores on the 4-point IQA rubrics). The potential of the tasks she chose to implement were cognitively demanding and asked students to engage in the disciplinary activities of explanation, justification, and generalization (Boston, 2012). Alice consistently maintained the high-level cognitive demands of tasks throughout the lessons. She was especially effective at leading a whole class discussion in which she supported multiple students in explaining and justifying their mathematical reasoning by pressing students to provide evidence for their contributions. Alice's IQA scores indicate both that she had developed relatively sophisticated instructional practices (Boston, 2012) and that she was a more knowledgeable other with regard to ambitious instruction than the other participating teachers in her school. Her

relatively accomplished practices as a mathematics teacher grounded her practices as a coach. For example, when she co-taught with and modeled particular instructional practices for teachers, she was able to respond to students in ways that supported their learning and could steer lessons in productive directions, thereby enabling teachers to participate in or observe ambitious instruction.

Coaching Practice I: Identifying Long-Term Goals for Teachers' Development

Here we describe Alice's long-term goals for teachers' development and her reasons for these goals, as well as the forms of knowledge that are inherent to identifying these goals. Alice was asked to describe her goals for supporting teachers. In Year 2, she replied that, "one [of my goals] is to help improve their mathematical content knowledge…and [another is] improving their delivery as far as the [new curriculum] program goes." She consistently named these two long-term goals for teachers' development each year she was interviewed.

Alice's focus on teachers' mathematical content knowledge as a goal for teachers' development reflected her concern that some teachers had limited mathematics backgrounds and limited experience in teaching mathematics. For example, Alice observed: "[One] teacher that just came to math this year; she had been teaching English for eight years and didn't really know a lot of the math content" [Year 2]. As we have noted, none of the seven mathematics teachers in Alice's school had completed more than four higher education courses in mathematics or mathematics methods. We hypothesize that the forms of knowledge inherent in Alice's identification of this goal included her relatively deep knowledge of mathematics for teaching across the middle grades, her knowledge of the mathematical ideas that could come to the fore

when the new curriculum was used effectively, and her knowledge of students' mathematical reasoning.

Alice's second goal is related to how teachers and students engage in mathematics teaching and learning. As noted above, the district had adopted CMP2 in the 2006-2007 school year, having previously used a more traditional textbook series. Alice's efforts to support teachers in using this ambitious curriculum effectively were influenced by her image of what high-quality, inquiry-oriented instruction looks like. We refer to this image as her *instructional vision*, which we hypothesize as a form of knowledge associated with the goal of improving teachers' instructional practices. A coach's instructional vision encompasses her articulated view of aspects of classroom instruction she considers important, together with a rationale for each aspect (Munter, 2014). As the instructional vision that Alice articulated in the interviews remained remarkably stable across years, we synthesized these interviews into a single account describing her view of the role of the teacher and the role of discourse.

View of the role of the teacher. Alice described the role of the teacher as "not being directive in front of the room," but instead "being off to the side, facilitating." According to Alice, the teacher should begin the lesson by leading students into the task through addressing key terms of the task and "activating students' prior knowledge" while being careful not to reduce the level of cognitive demand by furnishing a solution method. She indicated that once the task has been introduced, students should work in groups while the teacher moves around the room in order to "probe and push on students' thinking, without giving the mathematics away." The teacher should then lead a whole class discussion during which students are encouraged students to come to the board and explain their solutions. In this phase of the lesson, the teacher should ask questions that "sum up what was learned in the lesson." Alice also explained that it is

important for the teacher to assess students' understanding during the discussion by "listening to their talk about the task."

View of the role of discourse. Alice indicated that students should have opportunities to discuss mathematical ideas and to "voice out" their thinking. During the concluding whole class discussion, the teacher should ask groups of students to explain how they solved the task and press other students to "restate what the presenting student said in their own words" in order to "strengthen understanding," because students "need opportunities to hear someone else's way of working through a problem that they may not have thought of themselves." She clarified that these discussions enable teachers to assess whether a student "truly understands" the mathematical ideas and thus determine whether it is necessary to go back and clarify some of the ideas. Furthermore, the teacher should "model how to have these interactions" by asking question such as, "Do you agree with what they said? Why do you agree with them?" In addition, the teacher should press students to clarify their reasoning so that other students can better understand how they solved tasks: "Say more," "Tell me why you thought it was this way," "Where did that 3 come from?"

In summary, Alice had not merely developed accomplished ambitious instructional practices but could reflect on those practices and identify key aspects of her expertise that could then constitute goals for other teachers' learning. This suggests that the development of ambitious instructional practices is a necessary but not sufficient basis for accomplished coaching practices. It is also indicates the importance of coaches making their instructional practices objects of reflection and analysis.

Coaching Practice II: Assessing Teachers' Current Instructional Practices

Alice reported that her specific goals for an individual teacher's learning were based on her "knowledge of [the] teachers and their strengths and weaknesses," which she identified by "going in their rooms [and] watching them teach" (Year 2). Alice reported that when she observed a teacher's instruction, she looked for any mathematical errors made by the teacher and how the teacher dealt with students' mistakes:

> If I'm in a classroom and I'm observing, [I notice if] they are…or a child is…making a [mathematical] mistake and they're not going back and correcting it or say[ing], 'Oh, wait a minute here, we've got a mistake. (Year 2)

Alice went on to clarify that her intent in taking this focus was to assess the teacher's current content knowledge, thereby informing her long-term goal of supporting the development of this knowledge.

Alice also reported that she also focused on whether "all students were able to work on the task" and had opportunities to "share their work with the whole class" (Year 4). In addition, she assessed how the teacher supported students through "questioning strategies," "talk moves," and setting "clear expectations" (Year 5). In focusing on these aspects of instruction, Alice was able to assess teachers' current practices with respect to her long-term goal of improving their implementation of the curriculum. Furthermore, it is apparent that Alice's sophisticated vision of ambitious instruction influenced her assessments of teachers' current practices. For example, her instructional vision emphasized classroom discourse that supported students' mathematical learning. This aspect of her vision oriented her assessment of teachers' talk moves and questioning strategies.

It is important to note that what Alice noticed in her role as a coach when she observed classroom instruction differs from what an accomplished teacher might notice (Sherin, 2001). An

accomplished teacher might focus on the forms of reasoning students are developing in relation to the instruction in which they are participating (Horn & Little, 2010). When Alice observed a teacher's instruction, she interpreted what was going on in the classroom with an eye toward supporting not merely students' learning but also, the learning of the teacher. Thus, in addition to focusing on what students were doing, Alice assessed the effectiveness of the teacher's current practices in supporting students' learning, while identifying problems of practice on which she could work with the teacher. The following excerpt, in which she described a debriefing conversation she had conducted with a seventh-grade teacher after observing her instruction, is representative in this regard.

> I had gone to observe, and during our post-conference, some questions [were], "How did you know this kid understood because they didn't say a peep the whole time during class?" And then, "Did you notice this child over here was quick to respond to every single question without giving the other kids a chance to think?" (Year 5)

In this instance, Alice noticed that the teacher did not support all students in communicating their mathematical reasoning, inferred that the teacher was not aware of this limitation of her current practices, and framed it as a problem of practice on which to work with the teacher. Thus, Alice assessed teachers' current instructional practices not merely in terms of student learning opportunities, but also in terms of potential teacher learning opportunities. In this regard, a professional vision for coaching builds on but is distinct from what Sherin and Han (2004) termed a "professional vision" for teaching (p. 179).

Coaching Practice III: Locating Teachers' Current Instructional Practices on Developmental Trajectories for Teachers' Learning

Alice's identification of potential teacher learning opportunities was informed by her knowledge of general trajectories for teachers' development. This form of knowledge would

appear to be specific to coaching and serves to further differentiate accomplished coaching from effective teaching. The developmental trajectories that Alice had delineated were grounded in her understanding of the teachers' practices when they used the prior traditional curriculum and of the learning demands inherent in reorganizing those practices. We call these *general* trajectories because her identification of *specific* learning goals for an individual teacher's learning (Coaching Practice IV) was informed by her assessment of their current instructional practices (Coaching Practice II).

Teachers' prior instructional practices. Alice explained that the new curriculum series differed significantly from the instructional materials the teachers had used previously:

> [The new curriculum] is a very different resource than what a lot of the teachers are used to in the past. With a regular textbook, they followed a Madeline Hunter-type style. [That style was] here's the notes; let's practice them together; now you do some on your own; and here's your homework. And they were very used to that before we got the [new curriculum]. With [the new curriculum], it's more of, we launch [tasks], let's talk about it a bit, you go try it, let's come together as a whole group. (Year 5)

Alice characterized the teachers' prior instructional practices as "stand and deliver" with "lecturing, doing some guided practice, and then letting students practice on their own," rather than letting the students "discover the math" (Year 5). She also indicated that when teachers first attempted to use CMP2 and saw students struggling, they wanted to offer a "quick fix" rather than letting students "wade through" challenges. She attributed this to teachers' views of their students' mathematical capabilities: "I think the teachers need to set their expectations higher, because they are so quick when a student struggles to bring the [level of] rigor down. And sometimes they bring it down too low for the students" (Year 5). In addition to making these

general observations that took account of the teachers' professional histories, Alice differentiated between the learning demands for new and veteran teachers.

Alice explained that new teachers "typically struggle with the pacing of [the phases of] the [CMP2] lesson" (Year 5). She typically focused on pacing with new teachers initially because she had observed that they often did not leave sufficient time for a whole class discussion. Alice indicated that when a new teacher was able to pace the phases of lessons adequately, she next supported their development of questioning strategies that would "deepen students' thinking." She clarified that the questions that new teachers initially ask often require only a "one-word" answers, such as, "What was the value you got for x?" Her intent was to support novice teachers to ask questions that "push kids' thinking," such as, "Well, I didn't see where you got that 3 from. Can you show me where it came from?" or "Why did you do it this way instead of this way?" (Year 2).

As we have already indicated, veteran teachers had previously taught mathematics by demonstrating methods for solving particular types of tasks and then providing guided practice and answering individual students' questions. Alice explained that, against this background, veteran teachers typically thought that they needed to "hold their [students'] hand through" CMP2 lessons (Year 5). Effective use of the new curriculum required that teachers introduce cognitively demanding tasks and then support students' exploration of the mathematics. Alice explained that veteran teachers were often uncomfortable with allowing students to explore the mathematics and often demonstrated a procedure for solving tasks, thus lowering the level of mathematical rigor for students. Alice's goal was to support these teachers in "activating [students'] prior knowledge" during the introductory launch so that they could begin to solve the task without the teacher guiding them each step of the way. Alice indicated that her subsequent

goals for new and for veteran teachers' learning "varied depending on their [individual] practices."

Coaching Practice IV: Identifying Immediate Goals for Individual Teacher's Learning

Alice identified problems of instructional practice that constituted immediate goals for individual teachers' learning by locating her assessments of their current instructional practices on the general trajectories that she had delineated for novice and veteran teachers' learning. Consider the example from a previous section in which Alice negotiated a problem of practice with a seventh-grade teacher: supporting all students to communicate their mathematical reasoning. In the debriefing conversation that she conducted with the teacher after the observation, she pressed the teacher to consider whether all the students understood the big mathematical ideas of the lesson. Alice and the teacher then determined that the teacher should focus on "get[ting] more kids involved in answering questions" (Year 5). The teacher gave a similar account:

> We were thinking about what types of questions I was asking them, and if it was just one person always answering or… was it the whole class answering? And so it really helped me realize that it was one person usually answering questions. So to do it a different way, give 'em a little more think time before one person is always shouting out. (Year 4)

This debriefing conversation focused on the content of questions as well as how to manage the discussion. The immediate goal that Alice identified for the teacher's learning was informed by her general trajectory for new teachers' learning (Coaching Practice III), which included supporting teachers' improvement of questioning strategies. As a consequence, the short-term goals on which she focused in this and other cases were steps toward supporting the teachers in

using the new curriculum effectively. These immediate goals then oriented her decisions about the types of activities in which to engage individual teachers.

Coaching Practice V: Designing Activities to Support Teachers' Learning

Alice had developed conjectures about how different types of activities could support teachers' improvement of specific aspects of their instruction. In the following paragraphs, we focus on Alice's rationales for these activities and draw on the teachers' accounts of their participation in these activities as they provide insight into the teachers' learning opportunities. The activities in which Alice engaged individual teachers were: modeling, co-teaching, and observing and debriefing (see Table 2).

Modeling. When asked what teachers might learn from watching her modeling instruction, Alice replied, "Hopefully…they would see differently the [way] of doing things in the classroom, and they would change their practice… [It gives] teachers an example of how a strategy can be done within their own classroom, with their own students." (Year 5) She then gave an example:

> If a teacher was taking too long on a warm-up, if they were taking 20 to 30 minutes on one problem that was supposed to be a five-minute problem, I could model that for them and show them how to transition into the next part of the lesson. (Year 5)

Alice clarified that whenever she modeled instruction, she consulted with the teacher in advance to identify the lesson she would model, and requested the teacher to focus on the specific aspects of her instruction that reflected her immediate goals for that teachers' learning. In orienting the teacher's observations in this way, she increased the likelihood that their subsequent conversation would be productive (West & Cameron, 2013).

Most of the teachers (5 of 7) reported that they had observed Alice model instruction in their classrooms multiple times over the course of the four years of the study. About half indicated that they had improved their understanding of how the successive phases of lessons should unfold. For example, an experienced eighth-grade teacher gave the following reply when asked what he "got out of" observing Alice model instruction:

> A more thorough understanding of, I guess, the focus, if you will, of CMP2. Basically, I would say [I learned about] how you would structure a class like that. Like I said before, I am used to being the one in charge of saying, 'This is what we are going to do.' She taught a very short lesson, and the kids worked the rest of the time. If I had not seen that, I would still be up here talking to kids, you know, and giving them maybe 10 minutes at the end of the period to work on it. (Year 1)

As this teacher's response indicates, developing an initial understanding of ambitious instruction was challenging for the teachers given their prior instructional histories. In this case, modeling followed by a debriefing conversation enabled the teacher to appreciate the benefits of engaging the students in the task much earlier in the lesson.

In addition to helping teachers develop an image of ambitious instruction, Alice aimed to support their development of high expectations for their students. A sixth-grade teacher recounted that at the beginning of her career she would "do a lot of the work and explanation for the students." However, after watching Alice model instruction in her classroom, she realized that her students were capable of doing the mathematics themselves:

> [Now] I get the kids to come up and do the problem piece by piece and I'm not actually the one doing any of the work… I learned that slowly, but surely. Seeing [Alice] model

> that in my class, definitely helped me to realize – Oh okay, well, the kids can do the work. (Year 3)

In this and other cases, Alice used modeling to challenge the teachers' view of their students' mathematical capabilities by demonstrating that their students could work through challenging mathematical tasks with only limited guidance.

In summary, Alice characterized modeling as a way of supporting teachers in developing an image of high-quality instruction that aims at ambitious learning goals. It is important to note that modeling included an explicit discussion of what she had done instructionally and why. One deeply held belief that Alice sought to challenge was that ambitious instruction was not feasible with their students. Challenging this belief is important as ambitious instruction requires that teachers develop productive stances about what their students are able to do (see Cobb, Zhao, & Dean, 2009; Coburn, 2003; Jackson, Gibbons, & Dunlap, in press). The teachers' accounts indicate that modeling supported them in understanding how to organize lessons in the new curriculum, in developing an image of ambitious instruction, and in developing a more productive view of their students' mathematical capabilities.

Co-teaching. Alice indicated that her conception of co-teaching had changed over the four years of the study:

> Co-teaching in the beginning… I did it more as, "Let me be your assistant. How can I help you in the classroom facilitate things; [do] different activities?" So I think that helped with just having an extra person in the room to get around to all the kids in the groups. To help [students] with their questioning, push their thinking further when the teacher may have been held up with a particular student or another group that was struggling. Over time…I would find myself planning more with the teachers and taking

> more of an active role in the classroom as far as helping with the instruction. So it went more from an aid role during co-teaching to more of I'm also helping your teaching. (Year 5)

Alice further explained that she had to establish a relationship of trust with the teacher in order for co-teaching to be successful: "Some teacher[s] – based on our past history together and be[ing] comfortable with each other – I knew that if I had a question that I wanted to pose to the kids that I could just jump in and ask it to the class. And we would feed off each other" (Year 5).

When asked what she hoped teachers would learn from co-teaching, Alice responded, "Mainly, I would say coming up with questioning strategies that [teachers] may not have thought of on their own…[and in subsequent lessons] when I wasn't there, they could bring those questions in their discussions" (Year 5). The value of this activity for Alice was that it enabled her to work with teachers on key aspects of ambitious instruction that were critical to the effective implementation of the new curriculum, such as questioning strategies. Her intent in co-teaching was that teachers would experience and come to appreciate the contributions of particular instructional practices and would subsequently attempt to enact these practices on their own.

A majority of teachers (5 7) reported co-teaching with Alice across multiple years. For example, a sixth-grade teacher reported that Alice had assisted her in orchestrating whole class discussions:

> If [Alice] sees that a student has done [the task] a different way, she'll point it out [to me]… So whenever we go over the answers or talk about what we've done, she'll say, 'Oh, so-and-so did it this way, you know, why don't you go up to the board?' So she knows the kids in my classroom… she'll help me out and call up the kids. (Year 4)

In this instance, Alice supported the teacher by selecting students to share their thinking based on whether their solutions would lead to discussions of mathematically significant issues.

In summary, co-teaching supported the teachers with whom Alice worked in appreciating the value of and learning to enact particular aspects of ambitious instruction such as questioning strategies and selecting students to call on during whole class discussions. The teachers were therefore able to try out instructional practices and analyze their impact on student learning with a more accomplished colleague (Ericsson, Krampe, & Tesch-Romer, 1993; Schön, 1987).

Observing classroom instruction and debriefing. As we have indicated, Alice routinely observed teachers' instruction in order to assess their current classroom practices. Observations also served as a means of supporting the teachers' learning as she usually identified problems of practice on which to work with the teacher, and sometimes gave feedback to assist in the teacher in refining the enactments of particular practices.

Alice and the majority of the teachers consistently reported that they had follow-up debriefing conversations after Alice made classroom observations as well as after modeling and co-teaching. Alice's accounts of how she typically structured debriefing conversations were remarkably stable across the 4 years:

> After I go observe them, and then we'll sit down together and I'll ask them, 'What went well? What do you think didn't go well?' And then we'll talk about it and come up with some goals for them to try and achieve and work on. (Year 2)

As Alice indicated, in the course of debriefing, she and the teacher typically negotiated a goal for instructional improvement and made a plan for how to proceed. The examples we have presented of debriefing conversations (e.g., "How did you know this kid understood because they didn't say a peep the whole time during class?" (Year 5) are representative and make it clear that she

did not merely encourage teachers to reflect on their classroom practices. Instead, based on her observations and her immediate goals for teachers' learning, she negotiated specific aspects of instruction with individual teachers.

During the interviews, the teachers did not talk specifically about what they learned from these debriefing conversations. However, Alice's description of a debriefing conversation that she had with a teacher about pacing the phases of lessons is relevant in this regard:

> Another teacher, their specific goal was transition and pacing…if you tell the kids you've got five minutes to do a task but then you end up giving 'em 15 because you've lost track of time, it kind of throws everything off course. So helping that teacher stick to the five minutes…[I said], 'Hey, I noticed you know you told them five minutes, but you gave 'em 15, you know. Have you [ever] used a timer? … How has that worked for you?' (Year 5)

In this instance, Alice focused the conversation on specific aspects of practice that the teacher could improve and offered suggestions for how she could do so.

In summary, debriefing was an important aspect of Alice's repertoire and occurred after modeling, co-teaching, and observing instruction. Alice's intent in debriefing with teachers was to negotiate a focus on particular problems of practice that then constituted immediate goals for the individual teacher's learning, supporting them in addressing these problems, and assessing the progress they were making.

Discussion

The intent of content-focused coaching designs is to provide teachers with ongoing, job-embedded support for improving the quality of their instruction and their students' learning. The purpose of the study that we have reported was to identify aspects of coaching knowledge and

practices that are implicated in designing activities that have the potential to support individual teachers' development of ambitious instructional practices. We examined the case of a coach who consistently engaged teachers in potentially productive coaching activities and identified five coaching practices that account for her design of activities: (a) identifying long-term goals for teachers' development, (b) assessing teachers' current instructional practices, (c) locating teachers' current instructional practices on general trajectories of teachers' development, (d) identifying next steps for teachers' development, and (e) designing activities to support teachers' learning. We also identified two forms of knowledge that were implicated in the coach's enactment of these practices: (a) knowledge of ambitious mathematics instruction and (b) knowledge of general trajectories of teacher's development of ambitious instructional practices.

The practices and the associated forms of knowledge clarify what coaches might need to know to and able to do beyond being accomplished teachers. Importantly, we distinguish between the professional visions of an accomplished teacher and an accomplished coach. When observing instruction an accomplished teacher might focus on the forms of reasoning that students' are developing in relation to the instruction in which they are participating. In contrast, the focal coach also interpreted classroom actions and interactions with an eye toward supporting teachers' improvement of their classroom practices. As we illustrated, she assessed teachers' current instructional practices not merely in terms of student learning opportunities but also, to identify potential teacher learning opportunities (e.g., developing questioning strategies that elicit multiple students' ideas). We therefore suggest that a professional vision for coaching builds on but is distinct from a professional vision for teaching, thus further clarifying what effective coaches need to know and be able to do in addition to having a relatively deep understanding of content and being accomplished teachers (cf. Elliott, et al., 2009).

Although we have analyzed the coaching practices of only one coach, we anticipate that our findings will have some generality in informing investigations of the practices of other coaches who are accomplished in supporting teachers' development of ambitious instructional practices, both in mathematics and in other content areas. To this point, few previous studies of coaching have framed the formulation and enactment of designs for supporting teachers' learning as a core aspect of coaching expertise. However, we realized after completing the analysis that our account of the focal coach's planning is generally consistent with the substantial body of work in mathematics education, science education, and the learning sciences on the process of developing, testing, and revising designs for supporting learning (Cobb & Gravemeijer, 2008; Lehrer & Schauble, 2004; Simon, 1995; Simon & Tzur, 2004). The set of coaching practices we have identified has strong parallels with analyses of how instructional designers develop designs for support. These accounts clarify that accomplished designers specify long-term goals for participants' learning, assess participants' current understandings to determine the instructional starting points, and formulate learning trajectories that comprise conjectures about both successive developments in participants' practices and the specific means of supporting those developments. As we have indicated, differences between formulating designs to support students' and teachers' learning concerns the forms of knowledge inherent in planning practices. Instructional designers formulate trajectories for students' learning in a particular content domain, whereas the focal coach drew on trajectories for teachers' learning that she delineated. We reiterate this point lest we be misinterpreted as suggesting that coaching practices and the associated forms of knowledge are the same as those of accomplished teachers. We contend that the practices and forms of knowledge identified in this analysis constitute a first step in clarifying what content-focused coaches need to know and be able to do if they are to support

teachers' development of ambitious instructional practices beyond being an accomplished teacher.

As we have described the focal coach's planning practices in linear terms for ease of explication, it is tempting to assume that coaches first establish goals for individual teachers' learning and then select activities in which to engage them. However, following Suchman (1987), we suggest that in practice their repertoire of coaching activities constrains the learning goals they establish for particular teachers, and that they revise those goals based on how teachers engage in the activities they select. If this is the case, then it is more reasonable to view the immediate learning goals they establish and activities they select for achieving those goals as mutually constitutive.

Our findings have implications for policy makers and for district leaders charged with developing and implementing coaching designs as they not only indicate potentially productive types of activities in which coaches should engage teachers but also specify provisional goals for coaches' learning. In particular, the forms of coaching knowledge and practice we identified can inform the selection and hiring of coaches and orient the design of activities for supporting coaches' learning. For example, an accomplished coach might support novice coaches in observing teachers' instruction and assessing their current instructional practices with respect to a trajectory of teachers' development, identifying short-term goals for individual teachers' learning, and selecting activities in which to engage particular teachers.

Because this analysis was exploratory, additional research is needed to further clarify what coaches need to know and be able to do when working with individual teachers. A limitation of our analysis is that we examined the practices of only one coach as she designed activities to support teachers' development of ambitious instructional practices. We were not

able to examine how she enacted various types of activities with teachers. Additional studies are needed that scrutinize and build on our findings while investigating directly how accomplished content-focused coaches design and enact various types of activities with teachers.

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Table 1

Alice's Scores on the Instructional Quality Assessment

Rubric	**Score**
Academic Rigor Potential of the Task	4
Academic Rigor Maintenance of the Task	3
Academic Rigor, Rigor of the Discussion	3
Accountable Talk Participation	3
Accountable Talk Teacher's Press	3
Accountable Talk Students' Providing	3

For rubrics, visit
http://peabody.vanderbilt.edu/docs/pdf/tl/IQA_RaterPacket_LessonObservations_Fall_12.pdf

Table 2

Number of Teachers Reporting Engaging in Different Coaching Activities

Activity	**Purpose Of Activity**	**Year**	**Number of Teachers**
Modeling	For teachers to see a different form of instruction, exemplifying of how particular instructional practices can be enacted with their own students	1	3
		2	3
		3	2
		4	3
Co-teaching	To support teachers in enacting particular instructional practices	1	2
		2	1
		3	1
		4	2
Observing and Debriefing	To discuss how the lesson went, account for key events that occurred during the lesson, and identify goals for the teacher to work on	1	3
		2	4
		3	5
		4	2

Notes

[i] We used interviews conducted in the second year of the study because it was also the second year of the implementation of the new curriculum and the second year of the implementation of the coaching design. We were curious what types of activities coaches and teachers engaged in after they had a year to become familiar with the new curriculum and coaching.

[ii] These data are for the 2010-2011 school year and were obtained from the National Center for Education Statistics website (http://nces.ed.gov/ccd/). Conversations with school leaders indicate that the student population was similar for 2007-2011.