WHERE'S THE MATH? A STUDY OF COACH-TEACHER TALK DURING MODELING AND CO-TEACHING

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This study explores how two instructional coaches enacted modeling and co-teaching cycles with five elementary teachers during mathematics instruction. A content analysis of the coach-teacher talk from 11 planning meetings and 23 lessons reveals that the coaches and teachers seldom engaged in mathematical conversations. Instead, they primarily had low-depth discussions about curriculum, other instructional materials, and assessment. Implications for school districts with instructional coaching models are discussed.

Keywords: Teacher Education-Inservice/Professional Development

Introduction

Recent reforms promote an ambitious vision of high-quality math instruction for all students (Martin & Herrera 2007; NCTM, 2014; Common Core State Standards Initiative, 2011). As this vision represents a significant shift from how many teachers learned and taught math (Hiebert, 1999), enacting this type of instruction requires much support (Ball & Cohen, 1999). To address this challenge, many schools are enlisting the help of instructional coaches, as their intensive, one-on-one support can embody many facets of effective professional development (Desimone & Pak, 2017). Given the significant financial investment coaching requires (Knight, 2012) it is critical that we understand its enactment, including emergent challenges and supports that can make it successful.

Literature and Research Questions

To impact classroom teachers' knowledge and instruction, both *individual* and *group* settings are important places of learning (Campbell & Griffin, 2017; Cobb & Jackson, 2015). However, research on *one-on-one* activities has received relatively little attention (Cobb & Jackson, 2011; Gibbons & Cobb, 2017).

In their conceptual analysis, Gibbons and Cobb (2017) identified two potentially productive coaching activities for individual teachers: *modeling* and *co-teaching*. According to the authors, these activities are potentially productive as they meet the standards of high-quality professional development, and have demonstrated a positive impact on teachers.

Despite the popularity of these two strategies, there is a surprising lack of research describing how modeling and co-teaching can be used effectively with experienced, practicing teachers. Most studies examining modeling and co-teaching have focused on pre-service teachers (Clarke et al., 2014; Scantlebury et al., 2008) or mentoring programs aimed to support novice in-service teachers (Feiman-Nemser, 2001). While a few studies have explored modeling or co-teaching with practicing teachers, they have primarily focused on literacy coaches (Bean et al., 2010; Vanderburg & Stephens, 2010). A small handful of math education studies with school-based coaches have touched on the practices of modeling and co-teaching, although that was not the main focus of their work (Campbell & Griffin, 2017; Ellington et al., 2017).

To address this gap, this study looks in-depth at the modeling and co-teaching cycles enacted by two coaches and five teachers during math instruction. Specifically, the following research

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question is addressed: What is the nature of coach-teacher talk during modeling and co-teaching cycles?

Framework

Prior literature suggests that two elements are important for teacher learning during professional development: (1) high-depth interactions; and a (2) focus on mathematics content.

High-Depth Interactions

In her 2003 paper, Coburn called upon education researchers to rethink how they conceptualize scale when talking about education reform. According to the author, scale has traditionally been operationalized in a quantitative sense, with the goal of increasing the number of schools and teachers involved in a reform. Coburn (2003), however, argues that this is a superficial way to measure scale-up, and that careful attention must be given to the four dimensions of depth, sustainability, spread and shift.

The dimension of depth is applicable to this study as it has been conceptualized as one way to demonstrate the opportunities teachers have to learn when engaged in social interactions (Coburn & Russell, 2008). Specifically, Coburn and Russell (2008) distinguish between low- and high-depth interactions, with low-depth focusing on "surface structures and procedures, such as sharing materials, classroom organization, pacing, and how to use the curriculum" (p. 212) and high-depth addressing "underlying pedagogical principles of the approach, the nature of the mathematics, and how students learn" (p. 212). Thus, it can be argued that teachers have limited opportunity to engage in meaningful learning if they are primarily exposed to low-depth interactions. We apply Coburn's (2003) concept of low- and high-depth interactions to understand teachers' opportunities to engage in meaningful learning experiences during modeling and co-teaching cycles.

Focus on Mathematics Content

Current research on effective professional development reflects a consensus that there must be a content focus (Desimone, 2009; Desimone & Pak, 2017). Furthermore, current literature on high-quality mathematics instruction states that teachers must possess a deep understanding of the math they teach (Martin, 2007; NCTM, 2014). Thus, in addition to engaging in high-depth interactions, teachers must also be provided with opportunities to deepen their understanding of the math content they teach during professional development.

Methods

Participants and Context

The participants included two elementary instructional coaches, Meg and Claire. Meg was in her second year as a coach and had spent 21 years prior as a teacher, and Claire was in her third year as a coach and had previously been a teacher for 10 years. During this study Meg modeled instruction for Teachers Michelle and Mackenzie (grades 3 and 4), while Claire co-taught with Teachers Cathy, Caroline and Cecilia (grades 5, 1, and 4). All teachers were rather experienced (range of 9-23 years of teaching), and all teachers and coaches were white females.

Data Collection

Primary data collection methods included observations and resulting field notes (Bogdan & Biklen, 2011), as well as transcripts generated from audio recordings of 11 planning meetings and 23 modeled or co-taught lessons (see Table 1).

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Table 1: Observation Data for All Coach-Teacher Pairs

	Modeling		Co-Teaching		
Coach	Meg		Claire		
Teacher	Michelle	Mackenzie	Caroline	Cecilia	Cathy
Grade Level	3rd	4th	1st	4th	5th
Lessons Observed	7	6	4	3	3
Planning Meetings	1	1	2	4	3

Data Analysis

All audio recordings were first transcribed using InqScribe software. The primary author then carefully read each lesson transcript and searched for places where the coach and teacher *directly engaged* with one another, typically through conversations and singular comments.

To look at coach-teacher engagement across the planning meetings and lessons, it was helpful to have a set of common codes. The authors primarily engaged in a process of open coding (Creswell, 2013) to develop two levels of emergent codes: (1) Level-1 Parent Codes; and (2) Level-2 Codes. Table 2 presents the Level-1 and -2 codes and how they are clustered.

Table 2: Level-1 and Level-2 Codes

Level-1 Codes	Management	Pedagogy	Content	Planning and Logistics	Contextual Factors	Other
Level-2 Codes	1) Classroom Composition and Attendance 2) Classroom Management	1) Grouping 2) Assessment 3) General Pedagogy	1) Curriculum, Activities, and Materials 2) Mathematics	1) Technology 2) General Plans for Coaching Cycle 3) Facilitator's Role 4) Time and Schedule	1) Relationship Building 2) External Requirements	1) External Individuals 2) Other

During the coding process, all codes were mutually exclusive and assigned at either the sentence (planning meeting data) or exchange (lesson data) level. After coding, we noticed a lack of talk directly focused on math, but there were many instances in which math-related terms were at least mentioned. To better capture all math-related talk (beyond the math-focused talk that was coded as Mathematics), we used a "Mathematics Indicator" to flag instances when the coaches and teachers used math words and phrases while discussing other topics, such as the curriculum, without attending to the mathematical meaning of those words and phrases.

The primary author coded all data and engaged in a reliability process with two independent coders trained in mathematics education research. During the reliability process, random subsets of data were independently coded by the both the primary author and an independent coder. Then, the two individuals met to reconcile differences. After talking through all areas of disagreement, overall, the coders agreed on over 97% of all assigned codes.

Last, to better understand the depth of the coach-teacher talk, the authors used Coburn and Russell's (2008) definitions of low-, medium- and high- depth and mapped their Level-2 Codes onto these three categories. Some of the Level-2 Codes closely mapped onto the definitions. For example, the exchanges coded as Curriculum, Activities and Materials mapped onto the low-depth category, as Coburn and Russell considered talk about "materials" and "how to use the curriculum" as low-depth. Other Level-2 Codes, such as General Pedagogy, did not cleanly fit with a single depth level, and such codes were divided into sub-codes and placed in the appropriate category. After the coding process, the authors tabulated frequencies and

percentages for all sets of codes to better understand the substance of the coach-teacher talk. For the planning conversations, percentages were tabulated at the character-level using NVivo software, while for the lesson-level data, percentages were calculated at the exchange-level.

Results

We begin by illustrating what was typical regarding the coach-teacher talk, including the most prevalent topics with examples. Given space constraints, we report data for the practices of modeling and co-teaching without details for each coach-teacher pair. We then explore the prevalence and examples of the Mathematics code, as well as the Mathematics Indicator. Last, we discuss the depth of all coach-teacher talk.

Modeling

Here, we describe typical coach-teacher talk for Coach Meg and Teachers Michelle and Mackenzie during their modeling cycles, which were focused on implementing Calendar Math. We were invited to observe one planning meeting for each pair, as well as 13 total modeled lessons. Transcripts from the planning conversations and modeled lessons were coded with the set of 15 Level-2 codes noted above.

Overall, the coach and teachers most frequently discussed: (1) Curriculum, Activities and Materials (25%); (2) Assessment (14%); and (3) Classroom Management (12%) (see Table 3). Each topic is discussed in more detail below.

Table 3: Coach-Teacher Talk for Modeling and Co-Teaching Cycles

	Modeling			Co-Teaching		
	Planning Meetings	Modeled Lessons	Overall	Planning Meetings	Co-Taught Lessons	Overall
	n=2	n=13		n=9	n=10	
Content						
Curriculum, Activities and Materials	26%	24%	25%	16%	23%	20%
Mathematics	4%	3%	4%	2%	3%	3%
Total	30%	26%	28%	18%	26%	22%
Pedagogy						
Grouping	0%	0%	0%	10%	11%	11%
Assessment	21%	7%	14%	18%	15%	17%
General Pedagogy	7%	1%	4%	18%	8%	13%
Total	28%	7%	18%	48%	34%	41%
Management						
Classroom Composition and Attendance	1%	13%	7%	0%	1%	1%
Classroom Management	2%	22%	12%	1%	2%	2%
Total	3%	35%	19%	1%	4%	3%
Planning and Logistics						
Facilitator's Role	2%	4%	3%	2%	10%	6%
General Plans for Coaching Cycle	7%	0%	4%	2%	0%	1%
Technology	0%	0%	0%	0%	8%	4%
Time and Schedule	16%	6%	11%	10%	4%	7%
Total	25%	10%	18%	14%	21%	18%
Contextual Factors						
Relationship Building	4%	15%	10%	4%	10%	7%
External Requirements	1%	2%	2%	4%	0%	2%
Total	4%	17%	11%	8%	10%	9%
Other	13%	4%	9%	12%	4%	8%

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Curriculum, Activities and Materials (CAM*).* When engaged in talk about CAM, across both cycles, the coach and teachers primarily discussed the materials needed to enact Calendar Math. This included conversations about the calendar, calendar pieces, number line, money, markers, wipes for the dry erase boards, popsicle sticks that would be used to elicit student participation, notebooks, making copies, and laminating materials. Typical exchanges coded as CAM included statements such as "I understand you have notebooks," "Do you have a sticky chart paper?" and "Do we have a dry erase marker?"

Assessment. Assessment was the second most prevalent theme during both modeling cycles. While engaged in assessment talk, the coach and teachers primarily conversed about assessment logistics, such as selecting which pre-made assessment to give students, as well as when students would take assessments and how long it would take. The following planning meeting excerpt is typical, illustrating how Coach Meg and Teacher Mackenzie decided when to give their pre-assessments:

Meg: 'Cuz the addition and the multiplication can be done at any time.

Mackenzie: These two can be?

Meg: Well, I mean, yeah. Unless you want to do a beginning baseline and an end baseline. It's completely up to you.

Mackenzie: I mean, we switch for almost, they come in at 11:15 and we don't switch back until 12:35.

Meg: That should be enough time to get 'em all in. (11/15/16)

Classroom Management. Classroom Management, the third most prevalent theme, most commonly surfaced during coach-teacher talk from the modeled lessons, rather than the planning meetings. The coach and teachers either praised students ("Such hard workers, Meg!"), or discussed classroom incentives ("I can honestly say that once everybody got focused and centered in here, they earned it today.") and challenging students ("I'm going to have to take her to the office if she won't do what she needs to do.").

In summary, during both modeling cycles, the coach and teachers primarily discussed immediate concerns related to planning and implementing the lessons, including materials, assessment logistics, and issues related to classroom management. We now examine the coach-teacher talk during the co-teaching cycles.

Co-Teaching

We were invited to observe 2-4 planning meetings and 3-4 co-taught lessons for each of the three coach-teacher pairs. Overall, the coach and teachers most frequently discussed: (1) Curriculum, Activities and Materials (20%); (2) Assessment (17%); and (3) General Pedagogy (13%). Each topic is explored below.

Curriculum, Activities and Materials. As CAM-related talk during the modeling cycles tended to focus on the materials, a different trend emerged in the co-teaching cycles as most of the CAM talk centered on the curriculum and activities. In particular, the coach and teachers often talked about issues related to: timing as they sequenced activities ("Do we want to try and have them do the first two problems…?"); the difficulty of the curriculum ("This is a hard lesson."); what students in groups should work on ("This would be good to do in a small group—this chart down here."); and understanding and/or navigating the curriculum ("Everyday Mathematics I think can be a little confusing...When I go through and look at this, I always look at the game to see if it's something that I can do whole group.").

Assessment. Similar to the modeling cycles, coach-teacher talk about assessment frequently surfaced during the co-teaching cycles. However, unlike the modeling cycles where the coach

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and teachers commonly discussed assessment logistics, during the co-teaching cycles it was more common for the coach and teachers to monitor student learning ("They did really well with expanded form the other day.") or use data to inform their instructional plans ("Why don't we use their independent work and kind of break them up into smaller groups?").

General Pedagogy. Last, unlike the modeling cycles where General Pedagogy rarely surfaced, during the co-teaching cycles, it emerged as one of the most frequently discussed topics. In particular, when the coach and teachers engaged in pedagogical conversations, they typically planned and/or created original materials that went beyond the district-provided curriculum ("We could just have an empty spot where they could write the number sentence or they can actually write a story problem."), discussed differentiation ("Ok, so the on-level group, we decided that it's just going to be higher level factors."), or engaged in more theoretical pedagogical talk ("So…you're doing more like student-led work out here during your centers?").

Hence, in some ways, the coach-teacher talk during co-teaching was quite different than the modeling coach-teacher talk. Specifically, modeling talk more often focused on materials, assessment logistics, and classroom management, while co-teaching talk more often focused on the curriculum and activities, monitoring student learning, utilizing data to inform their teaching, and engaging in pedagogical talk. Despite these differences, however, much of their discussions were rather similar, especially in terms of their limited math focus and depth.

Where's the mathematics?

The lack of math-focused conversation is striking across the modeling and co-teaching cycles. Specifically, only 2-4% of all planning meeting exchanges, and 3% of all modeled and co-taught lesson talk was coded as "mathematics" (see Table 3 above). In the rare instances in which the Mathematics code was used, it primarily captured procedurally-driven conversations about simple computation problems ("1 + 6 is not 5. Right? 1 + 6 would be 7."), definitions ("A multiple are all of the answers to a multiplication problem… The multiples of 4 are 4, 8, 12, 16 because 4 x 1 is 4, 4 x 2 is 8, 4 x 3 is 12."), and mathematical rules or procedures for textbook activities ("The box is not correct 'cuz 2 x 1 is not 3."). Conceptually driven mathematical conversations were, by far, more rare.

Mathematics Indicator. Although math-focused discussions were rare, the coaches and teachers often used math words and phrases while talking about other topics, such as assessment, without attending to the mathematical meaning of those words and phrases. Such instances were tagged with a Mathematics Indicator to reflect that a math term or phrase was listed, however it was not coded as Mathematics because it did not reflect a conversation about the content. For example, the exchange below received a primary code of Curriculum, Activities and Materials.

Claire: So, Wednesday, are we going back to 2.2?
Cathy: Yes, which is exponents.
Claire: I really like that exponents lesson. (3rd planning meeting, 9/19/16)

In addition to the CAM code, the underlined sentences were assigned a Mathematics Indicator, as the coach and teacher used the math word "exponents" while discussing the topic for the textbook chapter.

The Mathematics Indicator most frequently surfaced as the coaches and teachers named math words and phrases while discussing the Curriculum, Activities and Materials ("Lessons 2 and 3 are *exponents."); Assessment* ("This is probably a group that I feel like has a pretty good handle on *place value* compared to last year."); and General Pedagogy ("I don't know how to respond to these whole big *arrays* in your head.").

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Depth

As explained above, we used Coburn's (2003) concept of *depth* to explore teachers' opportunities to learn. During both the planning meetings and the modeled/co-taught lessons, the coaches and teachers engaged in primarily low- (63-92%) and medium- (7-33%) depth interactions, while high-depth interactions seldom occurred (1-6%) (see Table 5). This suggests that the coach-teacher talk heavily emphasized surface-level structures and procedures, rather than focusing on topics such as how students learn mathematics, for example. Still, more medium-depth interactions occurred during co-teaching (27%) than modeling (10%), and low-depth interactions were more prevalent during modeling (87%) than co-teaching (70%).

Table 5: Depth for All Modeling and Co-Teaching Cycles

	Low	Medium	High
Modeling Cycles			
Planning Meetings	82%	12%	6%
Modeled Lessons	92%	7%	1%
Overall	87%	10%	4%
Co-Teaching Cycles			
Planning Meetings	63%	33%	5%
Co-Taught Lessons	76%	20%	2%
Overall	70%	27%	4%

Discussion

In this study of two coaches and five elementary teachers, we found that coach-teacher interactions during modeling more often focused on materials, assessment logistics, and classroom management, while interactions during co-teaching more often focused on the curriculum, monitoring student learning, utilizing data to inform teaching, and engaging in pedagogical talk. These differences may be specific to the two particular coaches involved, or may be due to differences in the focus of the cycles (e.g., with modeled lessons centered around Calendar Math, which was materials-intensive and outside the regular curriculum). However, some differences seem likely due to the fact that during modeling, the teachers generally assisted the coach (consistent with the greater focus on materials and classroom management), while during co-teaching, the teacher and coach implemented lessons together. These differences in foci may have prompted the greater depth during the co-teaching discussions.

Still, across the modeling and co-teaching cycles, conceptual discussions about mathematics content were extremely rare. This is disappointing, considering decades of research recommending that effective professional development should have a content focus (Desimone, 2009; Desimone & Pak, 2017). The lack of mathematical depth of discussions may be due, in part, to the fact that both coaches were generalists who lacked specialized mathematics training and were expected to provide professional development in all content areas.

Although our findings require replication before definitive conclusions can be drawn, the results suggest two potential guidelines for school districts. First, professional development for instructional coaches should help coaches gain a deep understanding of math content and pedagogical content knowledge across the developmental spectrum, which will help facilitate deeper conversations about math teaching. Second, more consideration should be given to implementing a content coaching model at elementary schools. In this model, although coaches would likely be shared between schools, they would be content experts who are better able support teachers in their area of expertise.

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References

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In G. Sykes and L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3 – 32). San Francisco: Jossey-Bass.

Bean, R. M., Draper, J. A., Hall, V., Vandermolen, J., & Zigmond, N. (2010). Coaches and coaching in reading first schools. *The Elementary School Journal, 111*(1), 87-114.

Bogdan, R. C., & Biklen, S. K. (2011). Qualitative research for education: An introduction to theory and methods. Boston: Allyn & Bacon.

Campbell, P. F., & Griffin, M. J. (2017). Reflections on the promise and complexity of mathematics coaching. *The Journal of Mathematical Behavior*, *46*, 163-176.

Clarke, A., Triggs, V., & Nielsen, W. (2014). Cooperating teacher participation in teacher education: A review of the literature. *Review of Educational Research, 84*(2), 163 – 202.

Cobb, P., & Jackson, K. (2011). Towards an empirically grounded theory of action for improving the auality of mathematics teaching at scale. *Mathematics Teacher Education and Development*, *13*(1), 6-33.

Cobb, P., & Jackson, K. (2015). Supporting teachers' use of research-based instructional sequences. *ZDM*, *47*(6), 1027-1038.

Coburn, C. E. (2001). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher, 32*(6), 3 – 12.

Coburn, C. E., & Russell, J. L. (2008). District policy and teachers' social networks. *Educational Evaluation and Policy Analysis, 30*, 203 – 235.

Common Core State Standards Initiative. (2011). *Common core state standards for mathematics.*

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational researcher*, *38*(3), 181-199.

Desimone, L., & Pak, K. (2017). Instructional coaching as high-quality professional development. *Theory Into Practice, 56*(1), 3 – 12.

Ellington, A., Whitenack, J., & Edwards, D. (2017). Effectively coaching middle school teachers: A case for teacher and student learning. *The Journal of Mathematical Behavior*, *46*, 177-195.

Feiman-Nemser, S. (2011). Lessons from an exemplary support teacher. *Journal of Teacher Education, 52*(1), 17 – 30.

Gibbons, L. K., & Cobb, P. (2017). Focusing on teacher learning opportunities to identify potentially productive coaching activities. *Journal of Teacher Education*, *68*(4), 411-425.

Hiebert, J. (1999). Relationships between research and the NCTM standards. *Journal for Research in Mathematics Education, 30*(1), 3 – 19.

Knight, D. S. (2012). Assessing the cost of instructional coaching. *Journal of Education Finance*, *38*(1), 52-80.

Martin, T. S., & Herrera, T. (2007). *Mathematics teaching today: Improving practice, improving student learning*. National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*.

Scantlebury, K., Gallo-Fox, J., & Wassel, B. (2008). Co-teaching as a model for preservice secondary science teacher education. *Teaching and Teacher Education, 24*(4), 967 – 981.

Vanderburg, M., & Stephens, D. (2010). The impact of literacy coaches: What teachers value and how teachers change. *The Elementary School Journal*, *111*(1), 141-163.