Examining the Discursive Actions of Mathematics Coaches During Video-Assisted Coaching Cycles

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Abstract

Coaching has become a widespread form of professional development to improve learning opportunities for teachers, yet little is known about how mathematics coaches interact with teachers. Building on prior discourse studies from mathematics education and literacy coaching, I identified five different discursive moves for how coaches talk with teachers: invitation, suggestion, explanation, description, and evaluation. These discursive moves served as the primary codes for two projects in which I examined the discursive actions of mathematics coaches during their conversations with teachers within video-assisted coaching cycles. In the first project, I explored the different ways mathematics coaches talked with teachers during planning and debriefing conversations as part of video-assisted coaching cycles. I identified similarities and differences in the discursive tendencies of coaches and present implications of the variability in coaches' verbalizations. In the second project, I examined how mathematics coaches leveraged written annotations to support teachers' professional discourse about classroom events during synchronous debriefing conversations. Mathematics teachers and coaches created the annotations while asynchronously watching video of implemented lessons as part of a video-assisted coaching cycles. I examined the extent to which coaches and teachers discussed the annotations during debrief conversations in coaching cycles, the discursive moves used by coaches when discussing annotations, and the characteristics of annotations (e.g., content, analytic stance, specificity) that were most commonly taken up in debriefing conversations. I present a rationale for needing increased articulation about the relationships between video annotations, the discursive actions of mathematics coaches, and professional discourse as well as the implications of such knowledge for mathematics teacher education.

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Dedication

This dissertation is dedicated to my two children, Kellen and Kinley, with the hope that you always keep your fierce curiosity and continue asking difficult and thought-provoking questions.

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

Coaching has become a widespread form of professional development used throughout the United States to improve learning opportunities for teachers (Campbell & Griffin, 2017; Desimone & Pak, 2017). The use of coaching spans across multiple subject areas with a particularly heavy concentration in mathematics and literacy education (Kraft et al., 2018). The continual rise in coaching stems from the convergence of three developments within the field of education. First, educational policies have dramatically increased expectations for student learning and achievement (e.g., Common Core State Standards Initiative, 2010; No Child Left Behind Act, 2001). Next, educational researchers have drawn strong links between teacher quality and student learning; resulting in a significant push to improve instruction (Darling-Hammond, 2000). Finally, professional development opportunities have shifted away from one-time workshops to learning activities that are active, on-going, collaborative, and embedded in a teacher's daily practice (Desimone, 2009; Borko et al., 2011).

Many studies from the educational research community have offered support for coaching. From a theoretical perspective, Desimone and Pak (2017) argued using coaching to support teacher learning tightly aligned to all five characteristics of effective professional development established by Desimone (2009). Similarly, Gibbons and Cobb (2017) stated specific coaching activities such as co-teaching and examining student work after a lesson

supported teachers in implementing high-quality instructional practices. Empirical studies have also demonstrated the effectiveness of coaching. Tschannen-Moran and McMaster (2009) conducted a quasi-experimental study in which all teachers attended a professional development workshop but only some teachers received follow-up coaching support. Teachers who received coaching reported higher levels of self-efficacy and demonstrated greater success with implementing new strategies than those who did not receive coaching. Sailors and Price (2010) similarly found adding a coaching component to a professional development workshop improved both the quality of teaching practices implemented after the workshop and student achievement on standardized tests. Within mathematics education, prior studies have shown coaching can positively impact the beliefs and practices of mathematics teachers (e.g., Ellington et al., 2017) in addition to improving student achievement (e.g., Campbell & Malkus, 2011).

Although there is evidence coaching can improve teaching and learning in mathematics education, results on the effectiveness of coaching have been inconsistent (Blazar & Kraft, 2015; Campbell & Griffin, 2017; Ellington et al., 2017). Each of these studies found substantial variability in the types of activities coaches used to support teacher learning and the impact of coaching on teachers and students. Campbell and Griffin (2017) directly argued the significant variance in coaching activities was responsible for the erratic outcomes. These findings are significant to the research in this dissertation. They highlighted the potential of coaching to improve teaching and learning in mathematics classrooms while also establishing a need for further knowledge about *how* mathematics coaches interact with teachers within various coaching activities (Gibbons & Cobb, 2016).

To address the lack of knowledge regarding how mathematics coaches interact with teachers, this dissertation contains two research projects focused on examining the actions of content-focused coaches when working with teachers during video-assisted coaching cycles. Within mathematics education, content-focused coaching (e.g., West & Cameron, 2013) is a common model. Content-focused coaching involves iterative cycles in which a coach works one-on-one with a teacher, with a focus on students' mathematical learning goals. Each coaching cycle contains three sequential components: a pre-conference discussion to plan a lesson; a collaborative lesson implementation; and a post-conference discussion to debrief the lesson (Bengo, 2016; West & Staub, 2003).

Although there is little research on how mathematics coaches interact with teachers, prior studies on literacy coaching highlighted two competing stances for how coaches talk with teachers: *reflective* or *directive* (Deussen et al., 2007; Ippolito, 2010; Sailors & Price, 2015). Coaches using a reflective stance facilitate improvement of teaching practices and student learning through collaborative inquiry (Ippolito, 2010). Coaching moves associated with this stance include probing questions and low-inference, non-evaluative observations as means to catalyze teacher thinking (Costa & Garmston, 2016). In contrast, a directive coaching stance involves the use of advice, suggestions, and evaluative feedback to support teachers to implement new teaching practices (Ippolito, 2010). Because these different coaching stances can have significant impact on the teacher's learning and uptake of new practices (Costa & Garmston, 2016; Heineke, 2013), it is crucial for researchers within mathematics education to explore the existence and impact of these stances during coaching.

To address this need, in the first study I examined the existence of *reflective* and *directive* stances of middle school mathematics coaches during their coaching cycle

conversations with teachers. The purpose of this study was to open up an examination of coaches' discursive tendencies to explore the variability in how coaches talk with teachers during coaching cycles. New knowledge about this variability will provide a foundation for future studies to examine how different discursive tendencies affect the teacher being coached. This understanding, combined with the new knowledge generated by the study, could provide practicing coaches with sound guidance about how to strategically balance and employ different discursive moves. This understanding could also lead to more strategic partnering of coaches and teachers by matching the discursive tendencies of a coach to the unique learning needs of a teacher.

Leaders of various coaching models (e.g., Knight, 2014) and professional development programs (e.g., Carson et al., 2019; Gregory et al., 2017; Matsumura et al., 2019) have also begun implementing coaching cycles in a fully online space. By pairing synchronous planning and debriefing conversations using teleconferencing software with video-recorded lesson implementations, online coaching cycles using video can make coaching more accessible to teachers regardless of their physical location (Matsumura et al., 2016). Viewing video of one's own teaching has been shown to effectively support teachers to identify areas of improvement (e.g., Borko et al., 2008; Harlin, 2014; Rosaen et al., 2008; Zhang et al., 2011), yet few researchers have examined the use of video within the context of coaching cycles. Specifically, little is known about how *what* is noticed by a teacher and coach during the viewing of lesson video impacts the debriefing conversation of a coaching cycle.

The second project within this dissertation addresses this lack of knowledge about coaches' actions during video-assisted coaching cycles by examining how coaches leverage

written annotations created by a teacher and coach while watching lesson video to support professional discourse around important classroom events during debriefing conversations. In addition to providing a foundation for future research on the relationship between video, noticing, and discourse, understanding how coaches utilize written annotations during debriefing conversations is vital to professional developers implementing online coaching activities and practicing coaches learning to use new technological tools within an existing professional learning structure.

Project Context

Both studies in this dissertation are situated within the coaching component of the SyncOn professional development project. SyncOn is an online, primarily synchronous, professional development opportunity for middle school mathematics teachers in rural areas (Choppin et al., 2015). The project has been implemented with two cohorts; each comprised of approximately ten teachers who participated in professional learning activities over the course of a two-year period. The professional development program focused on supporting teachers with generating student discourse in mathematics classrooms (Smith & Stein, 2011) and is comprised of three parts: (a) an online course; (b) online teaching labs; and (c) online video-assisted coaching (see Choppin et al., 2020 for a fuller explanation). The sole focus of both studies in this dissertation is on the coaching component of the professional development project; however, descriptions of the online course and teaching labs will be provided for necessary context.

Online Course

The online course, *Orchestrating Mathematical Discussions* (OMD), emphasized high-leverage discourse practices to facilitate productive classroom conversations (Smith &

Stein, 2011). These practices include anticipating, monitoring, selecting, sequencing, and connecting. To establish coherence with the video-assisted coaching cycles, the course also emphasized key aspects of lesson planning such as creating student learning goals and implementing high-cognitive demand tasks. The goals of the course were supporting teachers to: (a) develop an awareness of teacher and student discourse moves associated with facilitating productive mathematical discussions; (b) understand the role of high-cognitive demand tasks in generating mathematical discourse; and (c) develop mathematical content knowledge with a specific focus on making connections between big mathematical ideas. Each course session was hosted synchronously using teleconferencing software, Zoom, and lasted approximately 90 minutes. Teachers were provided 12 course sessions during their two years of participation.

Online Teaching Labs

Online teaching labs, the second component of the SyncOn model, involved participants collaboratively viewing and discussing lessons taught and video-recorded by project personal to make public the practices examined in the OMD course. The goal of the teaching labs was to help teachers notice how the intentional combination of tasks and teacher actions can result in student thinking that could be leveraged to develop students' understanding of important mathematical concepts. The teaching labs were a synchronous activity consisting of: (a) a preconference to discuss the mathematical goals of the lesson and anticipate student strategies; (b) time to view video clips of the lesson implemented by project personal; and (c) a debriefing conversation with a specific focus on student learning and teacher moves in relation to the lesson goals (see Amador, Callard, et al., 2019 for a

fuller explanation). Each teaching lab lasted approximately two hours and teachers were provided five teaching labs during their two years of participation.

Video-Assisted Coaching Cycles

The third component of the SyncOn model and the focus of both studies in this dissertation, video-assisted coaching cycles, involved both synchronous and asynchronous online activities (see Carson et al., 2019 for additional details). The planning and debriefing conversations of the SyncOn online coaching model consisted of the coach and teacher collaborating synchronously through Zoom to plan lessons and reflect on the effectiveness of those lessons (see Figure 1.1). A video-assisted coaching cycle began with the teacher completing a lesson planning document shared with the coach one to two days prior to the planning discussion. Project personnel designed the lesson planning document to elicit teacher thinking regarding learning goals for students, the lesson plan and tasks, and various other facets of the lesson creation process. The planning document also prompted teachers to select a personal learning goal from a list of seven high-impact practices associated with the OMD course. In addition to completing the planning document, teachers uploaded curriculum materials related to the lesson into a Google folder shared with the coach. This gave the coach an asynchronous opportunity to preview the mathematical content of the lesson and examine the teacher's thinking about the lesson plan before the synchronous planning discussion.

During the synchronous planning meeting via Zoom, the Google folder and files allowed the teacher and coach to view and edit lesson documents simultaneously, enabling an online process of collaborative lesson creation. The goal of the planning discussion was for the coach to support the teacher with: (a) establishing student learning goals around

important mathematical concepts; (b) designing a lesson involving high-cognitive demand tasks; (c) anticipating student strategies; and (d) establishing a personal goal for the teacher when implementing the lesson.

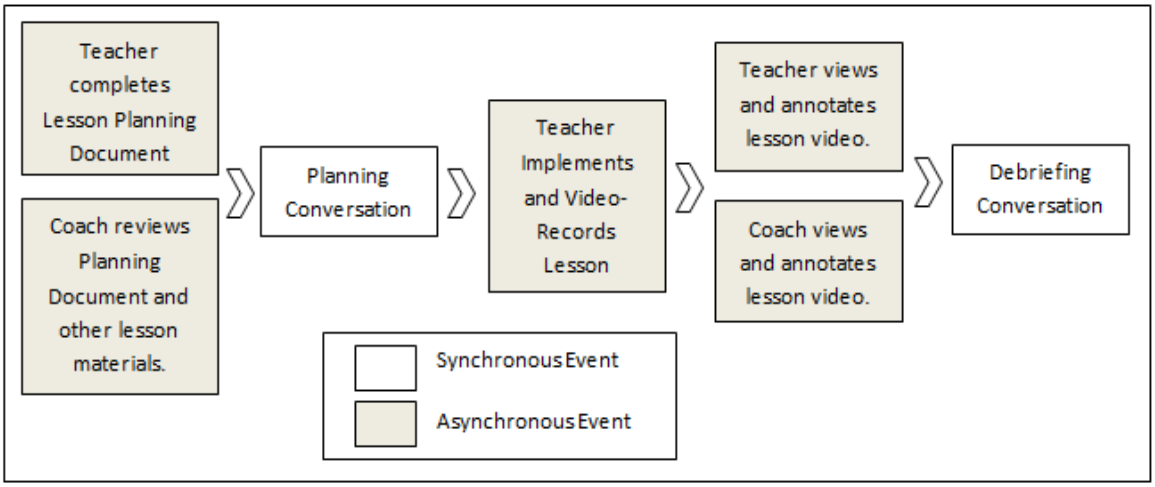

Figure 1.1. Events within the SyncOn online coaching cycle structure

After the synchronous planning conversation, the coaching cycle transitioned to an asynchronous lesson implementation process. This process began with the teacher video-recording the lesson implementation using a Swivl robot and paired iPad application. The Swivl robot pivots to video-record the teacher as they move around the classroom and uses additional makers to capture the audio of the students and teacher. Completed videos were automatically uploaded to a shared Swivl library allowing the coach and teacher to asynchronously view the lesson video. The web-based Swivl library also contains a feature enabling the teacher and coach to create annotations (e.g., a written comment or question) that becomes time-stamped with a specific moment in the lesson video. This feature also allowed the coach and teacher to select a specific annotation to immediately move to the corresponding time in the video and provide a response. In this online coaching cycle structure, the teacher viewed and annotated the lesson video prior to the coach who viewed and annotated the lesson video prior to the debriefing conversation (see Figure 1.1).

The video-assisted coaching cycle concluded with a debriefing discussion. Similar to the planning discussion, the synchronous lesson debrief was conducted using Zoom and a shared Google folder containing uploaded images of student work. The student work, combined with the video annotations, focused the debriefing discussion on student thinking and learning of mathematical content, next steps for instruction, and the personal goals of the teacher. During their two years of participation, each teacher was asked to complete four coaching cycles with their assigned coach.

In this dissertation, the first project investigated the discursive tendencies of coaches during the planning and debriefing conversations within the video-assisted coaching cycles. Data for this project was collected from all coaching cycles of three coaches during the first cohort of teachers. The second project examined how the coaches and teachers discussed the video annotations from the lesson implementation phase of the coaching cycle during the debriefing conversations. Data for this project was collected from a single coaching cycle for all coach/teacher pairs in both the first and second teacher cohorts.

Project Roles and Responsibilities

Within the SyncOn professional development project, I was a member of both the professional development and research teams. As a member of these teams, I was assigned numerous and diverse tasks. In this section, I describe my roles and responsibilities related to the research projects in order to articulate overlap between my research and professional development work. Additionally, I explain how my individual work for this dissertation intersected with the collaborative research work done by the SyncOn research team.

Professional Development Roles and Responsibilities

As professional development personnel, I served as a coach, conducting four video-assisted coaching cycles with one teacher from cohort two. Additionally, I engaged in many tasks preparing for and implementing the online teaching labs for both cohort one and two. These tasks included teaching lessons in the classrooms of participating teachers, planning the teaching lab sessions, editing lesson video, and facilitating the synchronous teaching lab sessions with participating teachers. Additionally, I was involved in regularly occurring professional development team meetings in which we planned for and reflected upon the numerous activities occurring within the model. My involvement in the teaching labs and coaching cycles was accounted for when developing the methodologies for both research projects and, when necessary, is described to position myself appropriately in the research.

Researcher Roles and Responsibilities

As a member of the research team, I was given two primary responsibilities related to video-assisted coaching cycles: (a) analyzing the discursive moves of coaches and (b) characterizing the annotations created by coaches and teachers when watching lesson video.

Analyzing the Discursive Moves of Coaches. My work with analyzing coaches' discourse moves began by collaboratively developing a codebook for analyzing the planning and debriefing conversations between coaches and teachers in video-assisted coaching cycles. This complete codebook contained three sections: (a) characterizing the discursive moves of the coaches; (b) characterizing the discursive moves of the teachers; and (c) the content of the conversations. My individual contribution to the collaborative work was the development of a coding scheme to characterize only the discursive moves of a coach. My personal development process involved open coding conversation transcripts (Corbin &

Strauss, 2008) and synthesizing created open codes with existing literature on teacher, facilitator, and coaching discourse within mathematics education. After proposing my section of the codebook to the research team, five researchers, including myself, tested the full codebook for reliability when coding transcripts from both planning and debriefing conversations. After a lengthy calibration process including numerous revisions of all sections of the codebook, we coded transcripts in pairwise teams.

Because this full codebook accounted for the discursive moves of both the coach and teacher as well as the content of the conversation, many research questions and secondary analysis options were available to the research team. For the first project in this dissertation, I individually created the research questions and the methodological processes for analyzing the coded discursive moves of a coach independent of the research team. Furthermore, I designed, conducted, and analyzed all secondary coding within the first research project in this dissertation.

Characterizing the Annotations of Coaches and Teachers. My second major responsibility for the SyncOn research team was to analyze the annotations of coaches and teachers as they watched lesson videos during the video-assisted coaching cycles. This work included collaboratively building a codebook to characterize the annotations, testing and refining the codebook, and ultimately, coding all annotations in pairwise teams (see Amador, Carson, et al., 2019 for a fuller explanation). The research in the second project in this dissertation built on this initial work of characterizing the annotations by examining the ways coaches and teachers discussed the annotations as part of their debriefing conversations. Although this study built upon collaborative efforts to characterize the annotations, I independently designed this follow-up study by creating the research

questions and methodological processes for analyzing the debriefing conversations for the presence of the annotations.

Conclusion

Little is known about how mathematics coaches interact with teachers (Gibbons & Cobb, 2016). The two projects within this dissertation address this gap by studying the discursive actions of mathematics coaches as they work with teachers during video-assisted coaching cycles. My professional development work with the teaching labs and coaching cycles components of the SyncOn professional development project was accounted for when developing the methodologies for both projects and, when necessary, is described to position myself appropriately in the research. Additionally, both projects in this dissertation are my individual efforts aiming to extend and advance the collaborative work of the SyncOn research team.

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Chapter 2

Literature Review

Discourse is the primary learning mechanism within coaching (Costa & Garmston, 2016). However, very few studies have examined coaching discourse specifically within mathematics education (Gibbons & Cobb, 2017; Lubienski & Saclarides, 2018). Therefore, this literature review aims to synthesize existing research on discourse within mathematics education to provide a foundation for a coding scheme for characterizing the discursive tendencies of mathematics coaches. This coding scheme is used within both studies in this dissertation. The literature review will begin by defining a discursive move. Next, because little research within mathematics education has been conducted on coaching discourse, this chapter will explore existing frameworks and coding schemes used to study discourse in other educational contexts. This includes both teacher and facilitator discourse moves within professional development activities other than coaching as well as the discursive moves of literacy coaches.

Defining a Coaching Discursive Move

Before examining professional discourse within education, it is important to provide a clear conceptualization and definition of a discursive move. Gee (2014) stated that analyzing discourse and language involves looking for connections between (a) what is being said, (b) the action or activity generating the discussion, and (c) the identities and roles of those participating in the conversation. In their analysis of mathematics teacher discourse

generated through watching video, Borko et al. (2008) further separated Gee's (2014) "what is being said" into two categories. The first was the content of the verbal statement. This included mathematical content, student thinking, or pedagogy. The second category was the type of conversation move teachers used to talk about the content. In other words, this category focused on *how* teachers were talking as opposed to *what* was being discussed. Within both studies in this dissertation, coaching discussions are viewed using a synthesis of Gee's (2014) and Borko and colleague's (2008) discourse conceptualization (see Figure 2.1). Each talk turn within a coaching discussion is made up of three components: (a) who is speaking (coach or teacher); (b) the content (what is being said); and (c) the discourse move (how it is being said). Each move is also mediated by the type of conversation (e.g., planning or debriefing) occurring between the coach and teacher. While each component of this conceptualization could warrant its own framework and corresponding research, the focus of the research projects in this dissertation is solely on the discourse moves of the coach.

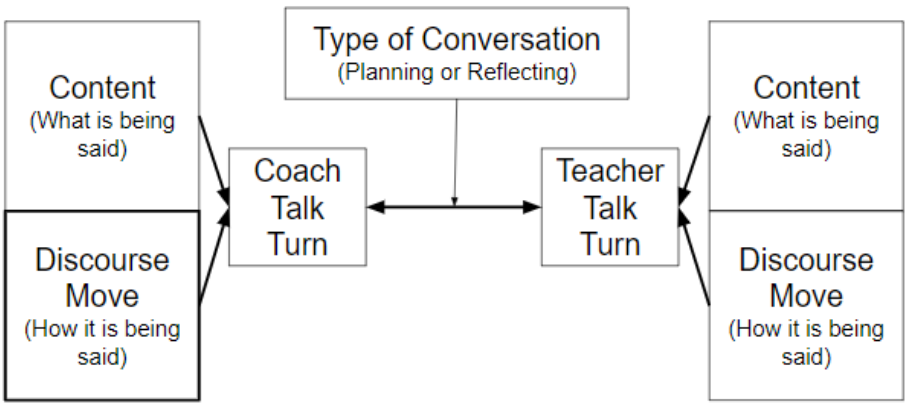

Figure 2.1. A conceptualization of a talk turn within the coach-teacher conversation

As a final introductory remark, there is an important distinction to be made about the ultimate goal of a coding scheme for the discourse of mathematics coaches. Researchers of much of the prior literature on educator discourse made arguments regarding the strengths

and weaknesses of particular discursive moves with respect to teacher learning. In contrast, the new codes articulated within this scheme are intended to be free of judgement regarding effectiveness or quality. The goal is not to build a coding scheme based on effective coaching moves identified as high-leverage by existing literature. Rather, it is to develop a comprehensive coding framework independent of prior assumptions about impact on teachers so it may serve as a foundation for future research regarding the discourse of mathematics coaches. To this end, existing literature will be used only to examine existing frameworks and codes for describing discursive moves; not to present and synthesize their findings about the impact of specific moves on teacher development.

Professional Discourse Frameworks

Due to the dearth of research on coaching discourse, this section focuses on discourse literature within a broader array of professional development activities in order to provide a foundation for a coding scheme for coaching discursive moves. In reviewing education literature for discourse coding schemes and frameworks, with a specific interest in mathematics education, three general areas emerged as potential sources. The first was literature focused on teacher discourse. This body of research examined how teachers talked in professional learning communities, video clubs, and a variety of other professional development settings. Although this subset of literature did not directly examine the discourse moves of a facilitator or coach, the researchers constructed frameworks with codes to describe the discussion moves between mathematics educators. The second area of potential interest included research on facilitator discourse. These studies developed frameworks and codes to label the talk moves of facilitators when guiding small-group professional development activities other than coaching (e.g., video clubs). Finally, a limited

number of studies have begun to explore coaching discourse, particularly within the area of literacy education. Therefore, the coding schemes of several coaching studies will be examined and compared to those developed for studying teacher and facilitator discourse.

Themes from frameworks and coding structures developed within each of these three areas will be presented to establish a foundation and justification for a coding scheme to characterize the discursive moves of mathematics coaches used within both research studies in this dissertation. The coding scheme for the discourse moves of mathematics coaches contained first-level codes to provide broad and mutually exclusive labels describing the overall nature of a coaches' discourse move. The existing literature will also be used to consider possible second-level codes future research may use to capture additional specificity. Organizing the coding scheme in this way was intended to support the initial analysis processes with clearly defined first-level codes and provide guidance for potential secondary analysis.

To be considered for discussion within this review, discursive codes had to be reoccurring across multiple frameworks or be highly applicable to the specific context of mathematics coaching discourse within coaching cycle conversations. Conversely, contextual differences between one-on-one coaching conversations and discussions found in other professional learning activities limited the applicability of certain established codes and frameworks. For this reason, codes lacking applicability to one-on-one coaching discussions will not be discussed even if they are common to multiple studies. For example, van Es et al. (2014) included a broad category of codes for "supporting group collaboration" in a framework for facilitator moves (p. 347). Since these moves are specific to a small

group context and do not apply to a one-on-one conversation, this part of the framework will not be considered.

Teacher Discourse Frameworks

With a shared interest in understanding how teachers talk with each other during professional learning activities, three studies created coding frameworks with potential relevance to mathematics coaching. Sherin and van Es (2009) studied teacher discourse in a video-based professional development environment (i.e., video clubs) in order to better understand the impact of participation on the professional vision of mathematics teachers. As part of their research, they created a coding framework containing a dimension to describe the ways in which the teachers talked about the events observed in the videos. This dimension contained the codes *describe*, *evaluate*, and *interpret*. The *describe* code applied to instances where "a teacher would provide an account focused on observable features of the activity in the video" (Sherin & van Es, 2009, p. 24). *Evaluate* was used when teachers provided judgement or critique about the quality of an activity observed in a video clip. *Interpret* captured discursive moves in which teachers made inferences about the interactions in the video.

Borko et al. (2008) similarly explored the discussion patterns of mathematics teachers in small groups as they collaboratively viewed videos of implemented lessons. Like Sherin and van Es (2009), they developed a coding framework with a category of codes to describe how the teachers talked to one another about the observed videos. As in Sherin and van Es' framework (2009), this category contained an identical *describe* code and a *critiquing* code analogous to *evaluate*. Borko et al. (2008) utilized the three additional codes *giving suggestions*, *asking questions*, and *identifying*. Discussion moments were coded as

giving suggestions when teachers provided ideas for how the events in the video could be improved and *asking questions* if teachers raised any type of question related to the video. *Identifying* marked instances in which teachers related the events of the video or discussion back to their own experience or practice.

As a final source of codes within the context of teacher discourse, Horn (2010) examined teacher interactions and discussions within a professional learning community of high school mathematics teachers. The unique context of weekly department-led meetings over a two-year period resulted in a coding scheme very different than those created by Borko et al. (2008) and Sherin and van Es (2009). Horn (2010) found two forms of discursive moves: *replays* and *rehearsals*. A *replay* occurred when a teacher provided a detailed account of an occurred classroom event for the consideration of the group. During a *rehearsal*, the conversation shifted to the future as a teacher acted out or narrated the implementation of an imagined practice. The discourse form of *replay* built upon Little's (2003) notion of *representations of practice* which described how accurately and completely teachers verbally portrayed elements of their practice with colleagues. In a professional learning community context, a *replay* corresponds with *describe* in that a teacher is providing an account of an observable event. The *rehearsal* move connects loosely to Borko and colleague's (2008) *identifying* code since both moves highlight a teacher discussing a new idea in relation to their own practice.

When considering these teacher discourse coding schemes for use with mathematics coaches, it is worth returning to Gee's (2014) stance on discourse analysis regarding the importance of exploring connections between what is being said, who is saying it, and the activity generating the discussion. Each of the presented studies focused on the verbal

interactions of collaborating teachers who engaged in professional dialogue to improve their own practice. In contrast, coaches are tasked with orchestrating professional discourse to support the learning of teachers. Growing oneself versus supporting the growth of another are disparate goals with possible implications on the associated discourse. Therefore, while each of the codes discussed in this section (see Table 2.1 for summary) may apply to the discursive moves of mathematics coaches, it is important to examine literature on the discourse of professional development facilitators who share a similar goal of fostering teacher learning.

Facilitator Discourse Frameworks

Many of the codes found in teacher discourse frameworks were present, in varying capacities, within facilitator frameworks. For example, in researching the facilitation of video-based discussions within a mathematics department, Coles (2013) discussed the presence of both *describe* and *interpret* discursive moves for the teachers and facilitator. However, Coles (2013) also highlighted the critical facilitation move of helping teachers transition their discussions from descriptions to interpretations. This example illustrates the broader theme of facilitator frameworks needing to consider, and possibly include, teacher discourse moves in addition to those specific to a facilitator. Thus, the frameworks developed for studying the discursive moves of professional development facilitators were found to be more complex than those describing teacher discussions. For this reason, this section will report on the major coding themes identified within these frameworks as opposed to detailing each framework individually.

The first notable theme of facilitator discourse moves is questioning. Facilitator questioning is one of the most critical strategies for successfully facilitating professional

discourse (Elliot et al., 2009; Zhang et al., 2011; Zhang et al., 2010). While an *asking questions* code was present in one teacher discourse framework, each facilitator discourse framework reviewed for this paper contained some version of a questioning code. In their study of science teacher discussions of problem-based learning tasks, Zhang et al. (2010) built a single framework to describe the different forms of questions used by the facilitators. This framework included codes for soliciting general teacher thinking and pressing teachers for elaboration. Van Es et al. (2014) similarly found these two forms of questioning in their study of video club facilitation with mathematics teachers. They used the term *launching* to describe general prompts to gather teacher thinking and *pressing* to describe questioning moves which elicit further explanation or elaboration.

The overarching goal of each questioning-related facilitator code was to elicit and make teacher thinking public. Weiland Carter and Amador (2015) broadened this action beyond merely using questions through the use of the code *direct prompting*. Like questioning, *direct prompting* invited teachers to share their thinking about a specific idea but could include both statements and questions. This is a worthwhile distinction since certain statements can serve the same purpose as questions. For example, the facilitator statement, “Tell me more about what you mean”, fits the criteria of *pressing* even though it is not a question. A coding scheme for the discursive moves of mathematics coaches should consider this broader code of inviting thinking, through questions or statements.

A second major theme from the facilitation frameworks not found in teacher discourse literature is the action of *restating* and *revoicing* the ideas of a participating teacher. Zhang et al. (2011) found *revoicing*, along with questioning, to be one of the most common and most important facilitator moves. Van Es et al. (2014) similarly included this

move in their facilitator framework using the code *clarifying* to indicate instances where the facilitator would "restate and revoice to ensure common understanding of an idea" (p. 347). The inclusion of this code in these frameworks is noteworthy since the cognitive coaching model, commonly found within mathematics education (National Council of Supervisors of Mathematics [NCSM], 2019), heavily promotes this verbal action. *Paraphrasing*, as it is called in the cognitive coaching model, has been referred to as "one of the most valuable and least-used tools in human interaction" (Costa & Garmston, 2016, p. 48).

Regardless of the exact term used to describe the facilitative action, this discursive move connects strongly to the *describe* code found within teacher discourse frameworks. In these contexts, *describe* referred to a teacher providing an objective account of an observable event without inference or evaluation. In the case of facilitator *paraphrasing*, they are objectively *restating* the comments of a teacher, without inference or evaluation, in order to ensure a common understanding and to allow the idea to be built upon by others (Costa & Garmston, 2016; Zhang et al. 2011). Because this code is found within multiple facilitation frameworks and a prominent coaching model used in mathematics education, it is worthy of consideration for a mathematics coaching discourse coding scheme.

As a final discourse theme from the facilitation literature, Amador and Carter (2018) found facilitators often shared their own knowledge of either content or pedagogy during episodes of lesson study activities. They labeled this action *asserting expertise* and it often came in the form of a suggestion for improving an observed situation or their own interpretation of an event. While both suggestions and interpretations were found in teacher discourse frameworks, the use of these moves by a facilitator and their elevated position holds potential implications. For example, in the case of teacher discourse, a teacher offering

an interpretation of an event indicated higher levels of professional noticing (Sherin & van Es, 2009) or deeper thinking on the part of the teacher when compared to simply describing an event (Coles, 2013). Similarly, a teacher providing a suggestion about how the events in a video could be improved, in some cases, indicated connections forming between observed events and a teacher's own professional practice (Borko et al., 2008). For facilitators, who can often be perceived as more knowledgeable practitioners, providing suggestions or their own interpretations can appropriately be labeled *asserting expertise* since their words potentially hold greater power and influence than those of teachers. Despite the neutral stance of codes within the two dissertation studies regarding the quality of moves based on their impact on teacher learning, it is important to consider the presence of differential power relationships between the facilitator and teachers when considering a coding scheme for coaches.

Coach Discourse Frameworks

In the transition from teacher to facilitator discourse moves, the underlying goals of the focal actor shifted from engaging in discussion for professional self-improvement to guiding discussions to support the growth of others. A similarly significant contextual shift occurs in moving from facilitating small groups to one-on-one coaching. In the facilitator literature, professional developers were primarily guiding small groups of teachers to discuss artifacts of practice from a single teacher within the group or from an external source. The research on coaching discourse examined for this section focused on a coach interacting one-on-one with a teacher. These coaching discussions actively examined components of a teacher's own practice such as planning a lesson or debriefing the implementation of a lesson. Therefore, while the codes used in facilitator discourse

frameworks may connect and apply to coaching conversations, the contextual differences require an examination of existing coaching-specific coding schemes.

Collet (2012) created a set of discursive codes to study the ways coaches gradually scaffolded literacy teachers towards sustained independence with new practices. This set of codes included *making recommendations*, *asking probing questions*, and *offering praise*. Each of these codes for coaching discourse moves directly relates to teacher and facilitator discourse codes. For example, the action of *asking probing questions* to push teacher thinking was present in all facilitation discourse frameworks. Additionally, the coach *making recommendations* to the teacher for ways to improve instruction is akin to Amador and Carter's (2018) *asserting expertise* code for facilitators and Borko and colleague's (2008) *giving suggestions* code for teachers watching video. *Offering praise* also connects to Borko and colleague's (2008) *critiquing* code for teachers and Amador and Carter's (2018) *asserting expertise* code since praise involved the coach using their expertise to provide a positive evaluation of practice.

In a case study of a coach mentoring a new teacher, Mosley Wetzel et al. (2017) similarly developed codes around the coach asking questions and providing praise. However, their coding scheme also provided a potentially important code not readily found in facilitator discourse frameworks. Similar to the *describe* code used by Borko et al. (2008) and Sherin and van Es (2009), Mosley Wetzel et al. (2017) utilized a code related to a coach noticing and describing observed moments of teacher or student actions. Instructional coaching, another model commonly used in mathematics education (NCSM, 2019) also advocates for this coaching move. Specifically, the model encourages coaches to collect low-inference and non-evaluative data during lesson observations and present (or *describe*)

this data to the teacher during a debrief conversation for collaborative examination (Knight, 2007).

As a final framework for consideration, Bill and Speranzo (2019) developed a framework for productive coaching moves specifically within mathematics education. This framework was intended to support practicing coaches implement high-leverage discursive moves and support research examining coaching discourse. This framework included two codes that were present in other coaching and facilitating frameworks. Like Weiland Carter and Amador's (2015) *direct prompting* code, Bill and Speranzo (2019) used *invite teacher thinking* to describe coaching questions or statements that elicited teacher thinking as opposed to only including a questioning code. They also included the code *making suggestions,* similar to many other discourse frameworks, and *engage in rehearsal* much like Horn's (2010) teacher discourse code.

However, Bill and Speranzo (2019) also presented several unique codes that combined key characteristics of previously discussed moves. For example, the code *mark progress* described the coach naming an observed teacher action and explaining why this move supports student learning. As such, *mark progress* involves a coach first using a *describe* move followed by an *asserting expertise* move in order to explain why the teacher action was productive. As a second example, their code *make connections* involved a coach supporting a teacher in thinking about the relationship between content, pedagogy, and student thinking. Successful use of this move typically involved a coach *describing* an observed teacher or student action and *asking probing questions* to help the teacher think about possible connections.

Bill and Speranzo (2019) also established two codes for specific forms of *pressing* questions utilized by facilitators within the frameworks created by Zhang et al. (2010) and van Es et al. (2014). The first is *confirm or counter a claim with evidence*. This code described instances in which the coach pressed the teacher to provide concrete examples to either support or refute a previous claim about teaching or learning. The second, *call to action*, marks questions inviting teachers to commit to specific actions related to their goals. These codes are important as they suggest productive coaching moves may be combinations or specific forms of more general discourse moves.

Conclusion

Through the examination of existing frameworks for teacher, facilitator, and coach discursive moves (see Table 2.1 for a summary), a foundation has been established for a coding scheme specific to the discourse of mathematics coaches. The discussed codes were highlighted from educational contexts directly related to one-on-one coaching conversations within mathematics education. Therefore, based on the synthesis of codes for the discourse moves of teachers, facilitators, and coaches in existing literature, I argue the codes used within both dissertation studies are valid and mutually exclusive labels for characterizing coaching discourse moves.

Table 2.1
Summary of Teacher, Facilitator, and Coach Discourse Framework Codes

Teacher		Facilitator		Coach	
Move	Source	Move	Source	Move	Source
Describe	Sherin & van Es (2009); Borko et al. (2008); Horn (2010)	Question: general solicitation	Zhang et al. (2010); van Es et al. (2014)	Suggest	Collet (2012); Bill & Speranzo (2019)
Evaluate, critique	Sherin & van Es (2009); Borko et al. (2008)	Question: press	Zhang et al. (2010); van Es et al. (2014)	Question, invite teacher thinking	Collet (2012); Mosley Wetzel et al. (2017); Bill & Speranzo (2019)
Interpret	Sherin & van Es (2009); Borko et al. (2008)	Direct prompt	Weiland & Amador (2015)	Describe	Mosley Wetzel et al. (2017)
Giving suggestions	Borko et al. (2008)	Restate, revoice, paraphrase	Zhang et al. (2011); van Es et al. (2014)	Praise	Collet (2012); Mosley Wetzel et al. (2017)
Asking questions	Borko et al. (2008)	Asserting expertise	Amador & Carter (2018)	Mark progress	Bill & Speranzo (2019)
Rehearsal	Horn (2010)			Engage in Rehearsal	Bill & Speranzo (2019)
				Make Connection	Bill & Speranzo (2019)
				Confirm or counter a claim with evidence	Bill & Speranzo (2019)
				Call to action	Bill & Speranzo (2019)

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Chapter 3

Exploring the Discursive Variability of Mathematics Coaches within Video-Assisted Coaching Cycle Conversations

Coaching teachers to support their mathematics instruction is a promising practice to improve pedagogical implementation and content knowledge (Campbell & Griffin, 2017; Desimone & Pak, 2017; Neuman & Cunningham, 2009). Within mathematics education, a coach can be defined as an individual who (a) engages directly with classroom teachers to improve instructional practice and student learning of mathematics and (b) is knowledgeable in mathematical content, how students learn mathematics, and pedagogy related to mathematics (Campbell & Malkus, 2011; Hull et al., 2009). Prior studies have shown coaching can positively impact the beliefs and practices of mathematics teachers (e.g., Ellington et al., 2017) in addition to improving student achievement in mathematics (e.g., Campbell & Malkus, 2011). Despite the promise of coaching as a professional development option to improve teaching and learning in mathematics education, it has been hampered by inconsistent implementation (Blazar & Kraft, 2015; Campbell & Griffin, 2017). Numerous studies have found coaches spend their time in vastly different ways and engage teachers in a broad array of activities (e.g., Campbell & Griffin, 2017; Ellington et al., 2017; Gibbons & Cobb, 2016; Gibbons & Cobb, 2017).

In response to the variability hindering research on and consistent implementation of coaching, several models have been created to guide the actions of coaches. According to National Council of Supervisors of Mathematics [NCSM] (2019), three coaching models are

commonly used within mathematics education: (a) content-focused coaching (West & Cameron, 2013), (b) instructional coaching (Knight, 2007), and (c) cognitive coaching (Costa & Garmston, 2016). Although these models lack robust research supporting their effectiveness, they provide initial guidance for the education community regarding how coaches should interact with teachers to positively impact professional learning. Each of these three models promotes the use of a three-part sequential process, or coaching cycle, which includes: a pre-conference discussion to plan a lesson, a collaborative lesson implementation, and a post-conference discussion to debrief the lesson (Bengo, 2016). As a result, mathematics coaches commonly use a three-part coaching cycle when working with individual teachers to improve their practice (Mudzimiri et al., 2014).

Discourse, considered by this project to be the use of language to create meaning and facilitate interpretation (Gee, 2014), is the primary tool coaches use to influence teacher learning and growth (Costa & Garmston, 2016; Coburn & Woulfin, 2012). Each coaching model (e.g., content-focused coaching) promotes different discourse moves to support teacher learning during coaching cycle conversations (West & Cameron, 2013). Cognitive coaching, for example, recommends coaches use a strategic combination of probing questions and paraphrasing to mediate teacher thinking and strongly encourages coaches to avoid the use of suggestions (Costa & Garmston, 2016). Conversely, content-focused coaching suggests coaches use direct assistance moves such as suggesting and explaining as well as invitational questioning (West & Cameron, 2013; West & Staub, 2003). These differing stances regarding effective discourse moves convey potentially conflicting messages to practicing coaches when working with teachers. Therefore, the purpose of this

study is to open up an examination of the variability in how mathematics coaches talk with teachers during coaching cycles.

Research on the ways coaches interact and talk with mathematics teachers during coaching cycles is underdeveloped (Cobb & Jackson, 2015; Gibbons & Cobb, 2016). Because research on coaching discourse is scarce within mathematics education, this study draws on existing literature from literacy coaching. Research on literacy coaching highlights two competing stances for how coaches talk with teachers: *reflective* or *directive* (Deussen et al., 2007; Ippolito, 2010; Sailors & Price, 2015). Coaches using a *reflective* stance facilitate improvement of teaching practices and student learning through collaborative inquiry (Ippolito, 2010). Coaching discourse moves associated with this stance include probing questions and low-inference, non-evaluative observations as means to catalyze teacher thinking (Costa & Garmston, 2016). In contrast, a *directive* coaching stance involves the use of advice, suggestions, and evaluative feedback to support teachers to implement new teaching practices (Ippolito, 2010).

The different discursive tendencies and stances used by coaches during coaching conversations can impact teacher growth (Coburn & Woulfin, 2012; Costa & Garmston, 2016; Heineke, 2013). However, prominent coaching models within mathematics education recommend coaches use different, and often conflicting, forms of discourse and coaching stances when interacting with mathematics teachers (NCSM, 2019; West & Cameron, 2013). Therefore, it is crucial for researchers within mathematics education to examine the variation between the discursive tendencies of mathematics coaches during coaching cycle conversations. Additionally, research is needed on how the context of a coaching conversation can influence the discursive tendencies of a coach to illuminate how

mathematics coaches change their use of language to support teacher learning in different settings. These contexts include the goal of the conversation (e.g., planning or debrief) as well as the number of prior coaching conversations a coach has had with a teacher.

For these reasons, the following research questions guide this study:

(1) To what extent do discursive tendencies vary between mathematics coaches during coaching cycle conversations?

(2) To what extent do the discursive tendencies of mathematics coaches during planning conversations vary from those in debriefing conversations?

(3) To what extent do the discursive tendencies of mathematics coaches change across multiple coaching conversations with the same teacher?

Theoretical Framing

The theory of systemic functional linguistics (Halliday, 1978) guided this inquiry to provide consideration for how mathematics educators – including teachers and coaches – negotiate their participation in the discourse practices within the context of a specific mathematics education community (Herbel-Eisenman et al., 2015). Halliday (1978) stated users of systemic functional linguistics view language as a functional and social system which utilizes objects and resources to exchange meaning between participants. However, these objects and resources do not contain inherent meaning on their own. Instead, participants use language to create meaning for the objects and resources based on the context of a situation and their prior experience. Furthermore, Halliday (1978) claimed the systemic functional linguistics perspective accounts for the frequent choices made by language users, both conscious and unconscious, which are directly influenced by the

context of a particular situation and prior experiences. Language choices, in turn, impact the context of the situation and the experience of the participants.

When analyzing language within coaching conversations, researchers must consider both the context surrounding the conversation and the primary functions of language. Halliday and Hasan (1989) described three features of a context in which language is exchanged to further clarify and define the notion of context and its interconnectedness with language use: *field*, *tenor*, and *mode*. *Field* refers to what is going on within a situation, *tenor* describes the roles of those participating, and *mode* refers to the ways in which meaning is expressed. Building from this conceptualization, each instance of language then, "is about something, is addressed to someone, and uses a particular mode – spoken or written language for example – to express meanings" (Ebbelind & Segerby, 2015, p. 37). To communicate the primary functions of a language system operating within various contexts, Halliday (1978) described three meta-functions of language. The *ideational* metafunction, connecting directly to *field*, describes the content being discussed and how participants use language to share experiences. The *interpersonal* metafunction relates to *tenor* and focuses on how relationships are constructed through the exchange of language and how relationships impact the use of language. The third metafunction, *textual*, describes the way language is structured or organized and connects to *mode*.

All three metafunctions, along with their associated aspects of context, can be used to analyze meaning of language instances within particular contexts, such as those found in coaching interactions. The *interpersonal* metafunction and *tenor* are useful in framing this study because the role and title of a coach may carry potential power implications for coaching conversations with teachers (Mosley Wetzel et al., 2017). Within the broader

domain of systemic functional linguistics, Halliday and Matthiessen (2004) highlighted a system of negotiation focused on the interaction between language and participant roles as ideas are exchanged. This system of negotiation involves one speaker assuming a role of a primary "knower" relegating the other participant to a role of secondary "knower" during a linguistic exchange (González & DeJarnette, 2012). Although little research within mathematics education has examined the way coaches use language to negotiate roles with teachers, research on literacy coaching has highlighted two competing stances for how coaches leverage their role and potential position of power when talking with teachers: *reflective* or *directive* (Deussen et al., 2007; Ippolito, 2010; Sailors & Price, 2015). Coaches using a *reflective* stance use language to position the teacher as the primary authority when examining the effectiveness of their practice and student outcomes (Ippolito, 2010). Language associated with a *reflective* coaching stance includes questions and low-inference, non-evaluative observations as these moves invite teacher cognition and do not contain the thinking or opinions of the coach (Deussen et al., 2007). In contrast, a coach holding a *directive* stance uses discourse moves that position the coach as the "primary knower". These discourse moves include suggestions and evaluative feedback which both involve the coach sharing ideas built upon their opinions and beliefs (Ippolito, 2010).

Various studies within mathematics education have used systemic functional linguistics as a theoretical underpinning to examine student-to-student discourse (e.g., Herbel-Eisenmann & Otten, 2011), teacher-to-student discourse (e.g., DeJarnette & Gonzalez, 2016; Esquinca, 2011), and teacher-to-teacher discourse (e.g., Herbel-Eisenmann et al., 2015). Based on these prior studies in mathematics education and the articulation of

language as a social construction driven by choice and context, this study utilized systemic functional linguistics as a theoretical perspective to frame the research activities.

Related Literature

Coaching has become a widespread form of professional development in the United States to improve professional learning opportunities for teachers in the ultimate service of raising student achievement (Campbell & Griffin, 2017; Desimone & Pak, 2017). The use of coaching spans across multiple subject areas with a particularly heavy concentration in mathematics and literacy education (Kraft et al., 2018). The continual and rapid rise in the use of coaching stems from the convergence of multiple developments within the field of education. First, educational policies have dramatically increased expectations for student learning and achievement and placed increasing emphasis on improved learning outcomes from *all* students (e.g., Common Core State Standards Initiative, 2010; No Child Left Behind Act, 2001). Second, educational researchers have drawn strong links between teacher quality and student learning resulting in a significant push to improve instruction (Darling-Hammond, 2000). Third, research on professional development opportunities has identified one-time workshops as inadequate in improving teacher practice and highlighted the need for professional learning activities that are active, on-going, collaborative, and embedded in a teacher's daily practice (Borko et al., 2011; Desimone, 2009). Finally, research has offered both theoretical (e.g., Desimone & Pak, 2017) and empirical evidence (e.g., Campbell & Malkus, 2011) suggesting coaching is an effective option for improving teacher practices in ways that will raise student achievement.

"Unfortunately, the rush to implement coaching before strong theoretical models, or even well-defined job descriptions were in place has caused a good deal of confusion related

to the role and focus of coaching" (Denton & Hasbrouck, 2009, p. 155). The variance in viewpoints and understanding regarding the roles of coaches in education has been largely problematic for researchers aiming to create generalizable findings for an ambiguous form of professional development (Denton & Hasbrouck, 2009). Therefore, it is important for any study or professional development program involving the use of coaching to clearly articulate the goals and roles of a coach. The coaching activity within this study was guided by the content-focused coaching model because of its focus on content-specific pedagogy and student learning outcomes.

Content-focused Coaching

West and Cameron (2013) described content-focused coaching as a content expert helping a teacher develop deep and flexible knowledge of the content they teach and how students learn the content. Building upon this definition, content-focused coaching has two primary goals: (a) increasing the teacher's knowledge of a specific content area, such as mathematics, and (b) building the teacher's knowledge of effective instructional practices related to a specific content idea through a personalized, job-embedded program (Cobb & Jackson, 2011).

The primary activity used by content-focused coaches is a coaching cycle. A coaching cycle, in an in-person context, consists of three phases: (a) a planning discussion, (b) a collaborative lesson implementation, and (c) a debriefing conversation (West & Staub, 2003). From a content-focused coaching perspective, the primary task of a planning conversation is the collaborative construction of a lesson. Through this process, the coach supports the teacher in analyzing the mathematical goals of the lesson, the lesson design and mathematical tasks in the lesson, anticipated student thinking, and instructional practice

goals for the teacher (West & Cameron, 2013). During the collaborative lesson implementation, the coach and teacher fulfill various roles established during the planning session to teach the lesson. This may include the coach observing or teaching small or large parts of the lesson. The coaching cycle concludes with the coach and teacher reflecting on the success of the lesson using evidence of student learning.

The use of content-focused coaching cycles to improve teaching and learning has been shown to be effective. Teemant et al. (2014) found engaging in multiple three-part coaching cycles supported teachers in implementing learning from professional development workshops resulting in improved instruction. Matsumura et al. (2013) claimed teachers participating in content-focused coaching cycles led to improvements in both teaching practices and student outcomes. Sailors and Price (2015) reported similar findings and claimed content-focused coaching improved instruction and student learning. However, Sailors and Price (2015) also reported variability in the actions of coaches within the content-focused coaching model which impacted the effectiveness of coaching.

In addition to providing guidance about the role of a coach, goals of coaching, and high-leverage coaching activities, the content-focused coaching model articulates coaching behaviors, dispositions, and discourse moves associated with successful coaching. Specifically, content-focused coaching calls for coaches to use a combination of *direct assistance* moves in which coaches provide teachers with suggestions or explanations to improve a lesson and *invitational* moves which are statements or questions that invite the teacher to share their thinking or ideas (West & Staub, 2003). Productively balancing these differing discursive moves is a significant challenge for coaches as it requires discerning moments in which it is best to act as a more knowledgeable expert versus moments when it

is best to position the teacher to make decisions and reflect on their practice (West & Cameron, 2013).

There is a dearth of research, particularly within mathematics education, regarding how coaches balance their interactions and discourse with teachers (Gibbons & Cobb, 2016; Cobb & Jackson, 2015). While prior literature has examined *what* mathematics teachers and coaches discuss (e.g., Lubienski & Saclarides, 2018), to the knowledge of the researcher in this study, no peer-reviewed research exists examining *how* mathematics coaches talk to teachers during coaching conversations. This is problematic given the prominence of content-focused coaching within mathematics education and its emphasis on intentionally balancing discourse moves that direct teachers to act or think in a specified way versus those the invite their contributions.

Drawing on Research on Discourse in Literacy Coaching

Two studies on literacy coaching have moved beyond identifying the existence of coaching stances and have explored the patterns of coaching discourse. Heineke (2013) examined the nature of coaching discourse during one-on-one conversations between a coach and teacher. In this study, Heineke (2013) found a majority of the conversations between a coach and teacher could not be classified as coaching since the topics being discussed were not about teaching practices (e.g., logistics of state tests). Of those conversations considered to be coaching, the majority involved the coaches using directive discourse moves in which the coaches recommended the use of specific teaching practices regarding reading instruction. Furthermore, Heineke (2013) stated coaches tended to dominate the conversation by talking more than teachers. In these situations, in which coaches were directive and dominated the conversations, Heineke (2013) claimed

opportunities for teacher learning decreased. Conversely, during the limited situations in which the coach maintained a collaborative and inquiry-based stance, teachers contributed more to the conversations and were afforded greater opportunities for learning. Therefore, there is a need to explore the *variance* in the discursive tendencies of mathematics coaches.

The second study, conducted by Collet (2012), focused on the ways coaches adapt their discursive patterns over multiple conversations with teachers as a technique to gradually release responsibility. Collet (2012) found coaches decreased directive discursive actions, such as recommending, across multiple coaching conversations. Conversely, coaches maintained or increased discursive moves such as questioning across coaching interactions as a technique to scaffold teachers towards independence. These findings highlight the importance of understanding *changes* in the discursive tendencies of mathematics coaches across multiple coaching conversations with the same teacher.

Analyzing Discourse in Mathematics Education

Although few studies in mathematics education have examined coaching discourse, existing literature has analyzed the discourse moves used by mathematics teachers during professional learning events and professional developers facilitating small-group professional learning sessions.

Mathematics Teacher Discourse. With a shared interest in understanding how teachers talk with each other during professional learning activities, two studies created coding frameworks with potential relevance to analyzing the discourse of mathematics coaches. Sherin and van Es (2009) studied teacher discourse in a video-based professional development environment (i.e., video clubs) to better understand the impact of participation on the professional vision of mathematics teachers. As part of their research, they created a

coding framework containing a dimension to describe the ways in which the teachers talked about the events observed in the videos. This dimension contained the codes *describe*, *evaluate*, and *interpret*. The *describe* code applied to instances where "a teacher would provide an account focused on observable features of the activity in the video" (Sherin & van Es, 2009, p. 24). *Evaluate* was used when teachers provided judgement or critique about the quality of an activity observed in a video clip. *Interpret* captured discursive moves in which teachers made inferences about the interactions in the video.

Borko et al. (2008) similarly explored the discussion patterns of mathematics teachers in small groups as they collaboratively viewed videos of implemented lessons. Like Sherin and van Es (2009), their coding framework contained a category of codes to describe how the teachers talked to one another about the observed videos. Also, like Sherin and van Es (2009), this category contained an identical *describe* code and a *critiquing* code analogous to *evaluate*. Borko et al. (2008) utilized the three additional codes *giving suggestions*, *asking questions*, and *identifying*. Discussion moments were coded as *giving suggestions* when teachers provided ideas for how the events in the video could be improved and *asking questions* if teachers raised any type of question related to the video. *Identifying* marked instances in which teachers related the events of the video or discussion back to their own experience or practice.

Facilitator Discourse. A review of facilitation discourse literature revealed three major moves used by professional development facilitators to support teacher learning. Two of these moves relate to a *reflective* coaching stance as the moves do not contain the thinking or opinion of the facilitator and positioned teachers as the primary "knowers". The first of these moves, *questioning*, has been identified as one of the most critical strategies for

successfully facilitating professional discourse (Elliot et al., 2009; van Es et al., 2014; Zhang et al., 2010; Zhang et al., 2011). Weiland Carter and Amador (2015) broadened the action of facilitator questioning through the use of the code *direct prompting*. Like questioning, *direct prompting* invited teachers to share their thinking about a specific idea but could include either statements or questions. The second discourse move, *paraphrasing*, involves the facilitator restating the language of a participating teacher for the purpose of clarifying, establishing a common understanding, and allowing the idea to be built upon by others (van Es et al., 2014, Zhang et al., 2011). This discursive move connects to the *describe* code found within teacher discourse frameworks as *paraphrasing* objectively restates the comments of a teacher without inference or evaluation (Zhang et al., 2011, Costa & Garmston, 2016).

The third move facilitator move identified by Amador and Carter (2018) during lesson study activities, *asserting expertise*, connects to a *directive* coaching stance. This move involved facilitators sharing their own knowledge of either content or pedagogy and was communicated as a suggestion for improving an observed situation or an interpretation of an event. While both suggestions and interpretations were found in teacher discourse frameworks, the use of these moves by a facilitator and their elevated position holds potential implications. For example, in the case of teacher discourse, a teacher offering an interpretation of an event indicated higher levels of professional noticing (Sherin & van Es, 2009) or deeper thinking on the part of the teacher when compared to simply describing an event (Coles, 2013). Similarly, a teacher providing a suggestion about how the events in a video could be improved, in some cases, indicated connections forming between observed events and a teacher's own professional practice (Borko et al., 2008). For facilitators, who

can often be viewed as a more knowledgeable practitioner, providing suggestions or their own interpretations can appropriately be labeled *asserting expertise* since their words potentially hold greater power and influence than those of teachers.

Online Coaching

Educational institutions and professional development projects are using various technological tools to connect teachers more effectively to qualified coaches (Ermeling et al., 2015; Israel et al., 2013). Prior research, although limited, has identified several advantages with the use of online coaching. First, Francis and Jacobsen (2013) suggested the use of communicative technology can provide active and collaborative coaching opportunities for geographically dispersed participants by removing the barriers of physical location. Thus, online coaching can provide more equitable access to high-quality experts regardless of their physical location; reducing the sense of isolation often described by teachers in rural areas (Butler et al., 2013; Prouty, 2009). As a second advantage, online coaching allows coaching activities to occur both synchronously and asynchronously. This creates logistical flexibility enabling the coaching process to adapt to teachers' busy schedules and better provide job-embedded learning (Dede et al., 2008). Finally, online coaching has been shown to be equally effective in supporting teacher learning when compared to in-person coaching (Israel et al., 2013; Kraft et al., 2018). Advances in video conferencing technology allow online synchronous discussions to be an effective replacement for in-person conversations (e.g., Francis & Jacobsen, 2013) and the coach and teacher asynchronously viewing a video recording of the lesson can effectively replace the lesson implementation portion of an in-person coaching cycle (Matsumura et al., 2016).

Methods

This study examined the coaching component of a larger, fully online, professional development project created for middle school mathematics teachers working in rural areas (Amador et al., 2019; Choppin et al., 2015; Choppin et al., 2020). The project consisted of three parts: an online course, online teaching labs, and video-assisted online coaching cycles designed to improve teacher practices for implementing high cognitive demand tasks and facilitating mathematical discourse (Smith & Stein, 2011). Using a cohort model, ten teachers from grades 5-8 participated in the project over a two-year period. In the coaching cycle portion of the project, teachers were partnered with coaches using a modified content-focused coaching model (West & Staub, 2003).

Participants

This study focused on three coach/teacher pairs who engaged in video-assisted coaching cycles within the larger professional development project. These three coach/teacher pairs were selected because they met the project requirement of completing four coaching cycles which included engaging in one planning conversation and one debriefing conversation per coaching cycle. The four online coaching cycles occurred over the course of two years. Two of the three coaches (see Table 3.1) who worked with the cohort teachers had more than ten years of prior coaching experience and had used the content-focused coaching model (West & Staub, 2003) for at least three years. One coach was new to coaching teachers individually but had prior experience with facilitating various professional development activities in both online and in-person settings. Data for the project was collected from the planning and debriefing conversations of the three project coaches and their assigned teachers (see Table 3.2). One of the coach/teacher pairings

contained two teachers matched with a single coach. In this case, the teachers shared classroom teaching assignments (i.e., coteaching) and opted to be coached together by a single coach.

Table 3.1
Coach Demographics

Coach	Years of Classroom Experience	Years of Coaching Experience Prior to Project	Years of Online Coaching Experience Prior to Project
Alvarez	28	21	0
Bishop	28	14	1
Reiss	15	<1	0

Table 3.2
Teacher Demographics

Teacher	Course Taught during Project	Teaching Experience (years)	Math Teaching Experience (years)	Coach
Graham/Marks	7th Grade Math (co-taught)	8/1	6/1	Alvarez
Sandoval	6th Grade Math	17	1	Reiss
Wise	7th Grade Math	13	13	Bishop

Context: Video-Assisted Coaching Cycles

The goal of each video-assisted coaching cycle was to support participating teachers to successfully implement new discourse practices (e.g., Smith & Stein, 2011) learned during the online course and online teaching labs. Each coaching cycle followed the same structure and utilized both synchronous and asynchronous activities (see Figure 3.1). First, the coach and teacher participated in a planning discussion using video conferencing technology, Zoom, focused on a lesson proposed by the teacher. Guided by the content-

focused coaching model, the primary goal of this planning meeting was to collaboratively analyze the mathematical lesson goals, the tasks used in the lesson, anticipated student thinking, and instructional practice goals for the teacher (West & Staub, 2003). The coach used a variety of discursive moves during the planning conversation to co-create a lesson with the teacher involving a cognitively demand task while also supporting the teacher's learning of larger pedagogical concepts. Following the planning meeting, the teacher video- and audio- recorded themselves teaching the lesson using Swivl technology (automated video camera and recording). After the lesson was taught, the coach and teacher asynchronously watched and annotated the lesson video. The coaching cycle concluded with the coach and teacher engaging in a debrief discussion that utilized the annotations to reflect on student thinking in relation to the lesson goals as well as the teacher's personal goals for improving their instructional practice. The planning and debriefing conversations typically lasted forty to sixty minutes and are the focus for analysis for this project.

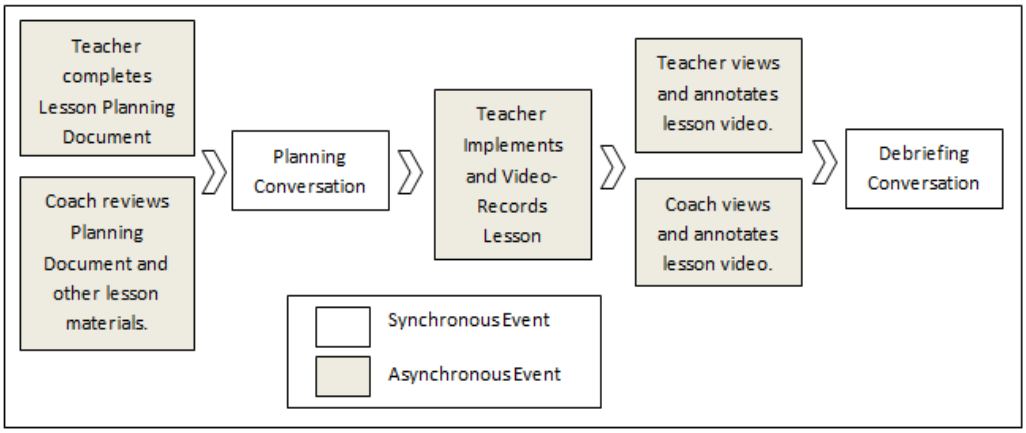

Figure 3.1. SyncOn video-assisted coaching cycle process

Data Collected

For this study, the planning and debriefing conversations of all four coaching cycles for the three coach/teacher pairs were analyzed. This resulted in the analysis of 12 planning conversations and 12 debriefing conversations. All 24 coaching conversations were

transcribed verbatim. Transcripts were parsed into stanzas which were defined as including the coach's discursive move and the teacher's response, as well as text needed for context (Saldaña, 2013). An individual discourse move of a coach, contained in the stanzas, served as the unit of analysis.

Data Analysis

The data analysis process began with the analysis of the stanzas within the planning and debrief conversations, using a comprehensive codebook. To create the codebook, the team first open-coded the coaching transcripts from the data set using constant comparative methods (Corbin & Strauss, 2008) to examine the discursive moves of the coach, the discursive moves of the teacher, and the content being discussed within each stanza. This resulted in a broad codebook accounting for the discursive moves of both the teacher and coach as well as the content of the conversations (see Choppin et al., 2020).

The section of the codebook for the discursive moves of the coach is the focus of the data analysis. The author of this study created the codes (see Table 3.3) for the discursive moves of a coach by synthesizing: (a) the initial open codes; (b) the discourse codes identified in prior studies on teacher and facilitator discourse in mathematics education; and (c) the discursive moves associated with reflective and directive coaching stances described in literacy coaching. The coaching discursive moves section of the codebook accounted for five broad categories. Each of the five discursive moves were connected to either a *reflective* or *directive* coaching stance by returning to the literacy coaching literature. *Suggestions*, *explanations*, and *evaluations* connected to a *directive* coaching stance as those moves all involved the coach sharing their thinking and opinions with the teacher which in turn positions the coach as an expert (Sailors & Price, 2015). *Invitations* and *descriptions*

connected to a *reflective* coaching stance because those moves position the teacher as the thinking authority since neither move contains the thinking or opinion of the coach (Ippolito, 2010).

Table 3.3
Excerpt from the Larger Codebook Focusing on Coaching Discursive Moves

Associated Coaching Stance	Discourse move code	Definition	Example	Source
Reflective	Invitation	Statement or question that directly invites the teacher to respond	"What might be some strategies we could use to increase student participation?"	Direct prompt – Weiland Carter & Amador (2015) Questioning – Zhang et al. (2010); van Es et al. (2014)
	Description	Statement that shares a direct observation and does not contain inference, interpretation, judgement, or opinion	"I noticed that during the turn-and-talk Alex did not say anything to his partner."	Describe – Sherin & van Es (2009); Borko et al. (2008) Restate, revoice, paraphrase - Zhang et al. (2011); van Es et al. (2014)
Directive	Suggestion	Statement that recommends a specific action for the teacher	"I think we should use a turn-and-talk prior to the whole class discussion."	Giving suggestions – Borko et al. (2008) Asserting Expertise – Amador & Carter (2018)
	Explanation	Statement that provides an interpretation or rationale of an event, interaction, or mathematical idea	"Allowing students to turn-and-talk with a partner prior to a whole class discussion is a powerful strategy because it increases student participation."	Interpret – Sherin & van Es (2009); Borko et al. (2008) Asserting Expertise – Amador & Carter (2018)
	Evaluation	Statement that offers praise or critique	"I think it was a great idea to use a turn-and-talk."	Evaluate – Sherin & van Es (2009); Borko et al. (2008) Asserting Expertise – Amador & Carter (2018)

Coding Coaches' Discourse Moves. To identify the individual discourse moves of the coaches, the unit of analysis, a two-step coding process was followed. First, pairwise teams of researchers coded each stanza in all planning and debriefing conversations for the discursive moves of the coach, the discursive moves of the teacher, and the content being discussed within each stanza. The researchers then calculated Kappa to determine reliability with coding and met to reconcile disagreements and come to final codes. Kappas ranged from 0.39 to 0.65, considered moderate to strong reliability (Landis & Koch, 1977).

Two examples are provided to clarify the ways the five discursive codes were used to analyze how the coach talked to the teacher. The following is an excerpt from a coach:

> One of the really nice moves you can do if the group shares a thought about something, and it's somewhat ambiguous, is you can turn to the class and say, "Can someone else use their own words to explain what Dave is saying?"

This comment from the coach was coded as a *suggestion* because the coach recommended the teacher action of using a question to promote additional student discourse. The suggestive discursive move implied the coach held a *directive* coaching stance at this moment in the conversation.

It was also possible for a coach to use multiple discursive moves within one stanza. To illustrate this, the following is a transcript from a debrief conversation in which the coach uses a *descriptive* move (lines 1 – 3) followed by an *invitational* move (lines 4 – 5):

> 1 I heard your kids saying, "No, four, no five. You need four, you need five."
>
> 2 You asked the question, "So how many full bags of dirt do you need to buy then?"
>
> 3 I heard the students continue to answers "four" and "five" after your question.
>
> 4 Based on these two different answers from the students, what can we infer about

5 the students' understanding of the mathematics in this task?

In this example from a debrief conversation, the coach recalled moments of the lesson and detailed what she heard the teacher and students say without inference or evaluation. She then questioned the teacher about the mathematics and students' understanding. Since she first described student and teacher actions and then invited dialogue from the teacher, this would be coded as both a *description* and an *invitation*. Both discursive moves suggested the coach was operating from a *reflective* stance at this moment in the conversation since no interpretation or opinion was provided by the coach allowing the teacher to construct their own meaning from the situation.

This first-step of the coding process reliably established the presence of specific coaching discourse moves within each stanza. However, this process did not capture two important aspects of the coaches' discursive tendencies vital to the research questions for this study. First, by only coding a stanza for the presence of a discourse move, the process did not capture the number of moves used in a single stanza since a coach might use the same discourse move multiple times. For example, a coach could provide a teacher with two different suggestions within a single stanza. Second, this process did not describe the order in which the coaches used different discourse moves within a stanza.

Therefore, as the second step of the coding process, the author of this study identified the individual discourse moves used by a coach within each coded stanza. This process involved first reviewing the codes previously assigned to a stanza and then highlighting the individual discourse moves of the coach using a color-coding scheme. In this scheme, invitations were highlighted blue, descriptions were highlighted green, suggestions were highlighted red, explanations were highlighted orange, and evaluations

were highlighted yellow. Figure 3.2 is provided to illustrate this process. This figure shows a complete stanza from a planning conversation transcript that had previously been coded as containing a *description*, *invitation*, and *explanation* for the discursive moves of coach Reiss during the first step of the coding process.

Stanza 4

Reiss:	When I read that standard, part of that standard was that they could interpret a remainder in a situation. Is that something else that you're hoping to get to? Do we want them to work with some remainders and interpret what that means in a context as well?
Sandoval:	Having an additional goal, say, being able to—I was going to say, you might want to—do they—even just say, evaluate a situation when there's remainders?
Reiss:	Right. In this standard, it says, let's see, solve multi-step word problems posed with whole numbers and having whole number answers using the four operations, including problems in which remainders must be interpreted. So, is that something that you want them to be able to do, I guess, and do we want them to be able to—do we want them to be able to interpret a remainder as part of this work?
Sandoval:	Yeah, I want them to do this because in this situation—and I know what they're doing with the lessons or the test tomorrow, is if you have a leftover, I mean, if you have the remainder, you still have to—they have to put things in boxes. How many boxes do you need? Do you still need to have that *[crosstalk 00:05:52]* if you have one left over it—there may be only one going in, but—
Reiss:	Exactly. I think that's an important part of what you want them to think about and what you're trying to get them to understand here, so…

Figure 3.2. Transcript excerpt to illustrate the second step of the coding process.

During the second step of the coding process, the author identified the presence of two descriptions (green), two invitational moves (blue), and one explanation (orange). Furthermore, the process revealed the ordering of the discourse moves within the stanza as description, invitation, description, invitation, explanation. Once all of a coaches' discourse

moves had been identified for a full conversation, a spreadsheet was created to sequentially record the coaches' discourse moves within the conversation. Figure 3.3 provides an example of a spreadsheet for Reiss's discourse moves during the first nine stanzas of a planning conversation.

Cycle	Conv.	#	Move	Stanza
2	Plan	1	invitation	2
2	Plan	2	describe	3
2	Plan	3	explain	3
2	Plan	4	describe	4
2	Plan	5	invitation	4
2	Plan	6	describe	4
2	Plan	7	invitation	4
2	Plan	8	explain	4
2	Plan	9	explain	5
2	Plan	10	explain	6
2	Plan	11	explain	7
2	Plan	12	explain	8
2	Plan	13	explain	8
2	Plan	14	suggest	9

Figure 3.3. Portion of a spreadsheet displaying the discourse moves of coach Reiss during the first nine stanzas of a planning conversation.

Analysis Process for Coaches' Discursive Moves. To begin analyzing the discursive tendencies of the three coaches, the first step was to calculate the total number of each of the five discursive moves used by a coach within a conversation. For example, during a planning conversation, coach Reiss used 60 total discourse moves. Of these 60 moves, Reiss used 29 invitations, three descriptions, 11 suggestions, 16 explanations, and one evaluation. These discourse counts indicated Reiss held both reflective and directive stances during the conversation. However, the higher combined frequency of invitational and descriptive moves (32 total) when compared to the combined total of suggestive,

explanation, and evaluative moves (28 total) suggested Reiss slightly favored a reflective coaching stance in the conversation.

Next, the researcher calculated an average for each discursive move by dividing the total number of discursive moves used in all conversations by the total number of conversations. For example, Reiss used a total of 149 invitational moves during eight conversations, resulting in an average of 18.63 invitational moves for a single coaching conversation. To characterize reflective coaching stances using the discursive moves, the researcher divided the sum of the number of invitational and descriptive moves by the number of coaching conversations. For example, Reiss used 99 description moves in addition to 149 invitational moves for a total of 248 reflective moves. Thus, over the eight conversations, Reiss averaged 31 reflective moves per conversation. Similarly, the average number of directive stance moves per conversation was calculated by dividing the sum of a coaches' suggestions, explanations, and evaluations by the total number of conversations. For example, Reiss used 226 directive coaching moves in the eight conversations resulting in an average of 28.25 directive moves per conversation. These counts and averages were used to examine how the discursive tendencies varied between coaches, how the discursive tendencies during planning conversations varied from those in debriefing conversations, and how the discursive tendencies of coaches changed across multiple coaching conversations.

Coding Conversational Segments Based on Changes in a Coaches' Stance.

Although numeric counts and averages provided insight into coaches' discursive tendencies, they did not describe how the coaches shifted their directive and reflective stances throughout a conversation. For example, recall the conversation from a prior example in which Reiss used 32 reflective moves and 28 directive moves. The approximately equal

number of reflective and directive moves indicated Reiss held both reflective and directive stances with similar frequency. However, these counts did not indicate how Reiss shifted between reflective and directive stances during the conversation. Reiss may have primarily used reflective moves during the first half of the conversation and then primarily used directive moves during the second half of the conversation. This theoretical example would indicate Reiss held a highly reflective stance during the first half of the conversation and then shifted to a highly directive stance during the second half. However, it was also plausible that Reiss frequently alternated the use of reflective and directive moves creating a more balanced coaching stance through the conversation.

Therefore, to move beyond numeric counts and further explore the unique and nuanced ways each coach shifted their coaching stances during conversations, the researcher identified *conversational segments* based on changes in the percentage of reflective moves within smaller sets of discourse moves. This identification process first involved visually inspecting the sequential list of all discourse moves for a conversation and grouping discourse moves into smaller sets of based on patterns in the number of reflective moves or directive moves (see Figure 3.3). Once a conversation was separated into these initial smaller sets, the researcher calculated the percentage of reflective moves within each set. Then, these small groups of discourse moves were adjusted to create the smallest number of groups that captured all conversational segments that contained significantly different percentages of reflective moves. During this analysis process, the researcher determined a conversational segment should ideally contain at least seven coaching discursive moves to ensure a trend in the stance of the coach. However, in extreme cases in which coaches shifted their use of reflective and directive moves significantly (e.g., five consecutive

suggestions followed by five consecutive invitations), conversational segments could contain as few as five coaching discourse moves.

Five categories were created to characterize a coaches' stance within a conversational segment based on the percentage of reflective moves used within the segment. A conversational segment was coded:

- *Highly Reflective* if greater than 80% of the discourse moves in the segment were reflective,
- *Moderately Reflective* if greater than 60% but less than or equal to 80% of the discourse moves in the segment were reflective,
- *Balanced* if greater than 40% but less than or equal to 60% of the discourse moves in the segment were reflective,
- *Moderately Directive* if greater than 20% but less than or equal to 40% of the discourse moves in the segment were reflective,
- *Highly Directive* if less than or equal to 20% of the discourse moves in the segment were reflective.

To illustrate the process of identifying and coding conversational segments, consider Reiss's planning conversation from coaching cycle three (see Figure 3.4). In coaching discourse moves one through 16, Reiss used 14 reflective moves (12 invitations and two descriptions). This conversational segment (containing 16 total coaching discourse moves) was coded *highly reflective* since 87.5% of the discourse moves were reflective. In coaching discourse moves 17 through 27, Reiss used one reflective coaching move (one invitation). This conversational segment (containing 11 total coaching discourse moves) was coded *highly directive* since 9.1% of the discourse moves were reflective.

Cycle	Conv.	#	Move	Stanza
3	Plan	1	invitation	2
3	Plan	2	invitation	2
3	Plan	3	describe	2
3	Plan	4	invitation	3
3	Plan	5	describe	4
3	Plan	6	invitation	4
3	Plan	7	invitation	4
3	Plan	8	invitation	5
3	Plan	9	invitation	6
3	Plan	10	invitation	6
3	Plan	11	invitation	7
3	Plan	12	explain	8
3	Plan	13	invitation	9
3	Plan	14	explain	9
3	Plan	15	invitation	9
3	Plan	16	invitation	9
3	Plan	17	explain	10
3	Plan	18	explain	11
3	Plan	19	explain	12
3	Plan	20	suggest	12
3	Plan	21	suggest	13
3	Plan	22	suggest	13
3	Plan	23	explain	14
3	Plan	24	invitation	14
3	Plan	25	explain	14
3	Plan	26	evaluate	14
3	Plan	27	suggest	14

Figure 3.4. Portion of a spreadsheet displaying the first 27 discourse moves of coach Reiss during a planning conversation.

To represent the coaches' stance within a conversational segment, a color-coding scheme was created (see Figure 3.5). Rectangles within the larger bar representing highly reflective conversational segments were colored blue, moderately reflective conversational segments were colored light blue, balanced conversational segments were colored light green (the mixture of blue and yellow), moderately directive conversational segments were colored light yellow, and highly directive conversational segments were colored yellow.

Stance Code	Highly Directive	Moderately Directive	Balanced	Moderately Reflective	Highly Reflective
Percentage of Reflective Moves in Segment	≥ 0% ≤ 20%	> 20% ≤ 40%	> 40% ≤ 60%	> 60% ≤ 80%	> 80% ≤ 100%
Assigned Color					

Figure 3.5. Color-coding scheme for conversational segments.

To visually represent the coaches' differing stances in the conversational segments, each conversation was displayed as a horizontal bar (see Figure 3.6). The length of a bar represents 100% of the discourse moves used during the conversation. Therefore, each bar for each conversation was the same length and could be visually compared. Each bar was then divided into smaller rectangles based on the number of conversational segments contained in a conversation. For example, a bar representing a conversation with four conversational segments would be displayed with four smaller rectangles. The length of each rectangle in the bar represented the length of the conversational segment as a percentage of the full conversation. This percentage was calculated by comparing the number of discourse moves in the conversational segment to the number of discourse moves in the whole conversation. For example, if a conversational segment contained 20 discourse moves and the entire conversation contained 80 discourse moves, the length of the conversational segment was displayed as a rectangle with a length 25% of the length of entire bar.

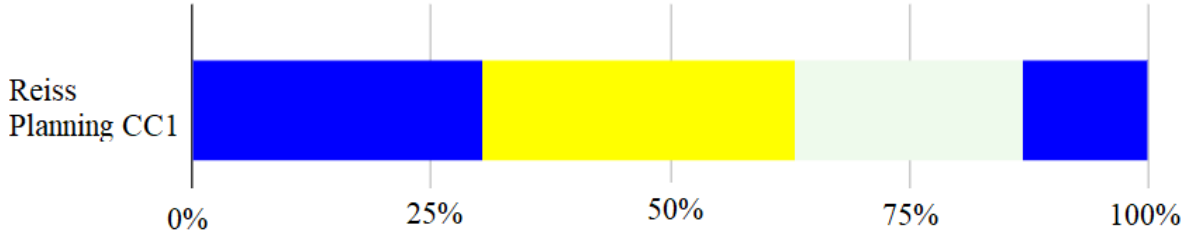

Figure 3.6. The visual representation of a single conversation.

To illustrate the creation of this visual display of a coaching conversation (see Figure 3.6), an example is provided using Reiss's planning conversation from coaching cycle one. In this conversation, Reiss used 46 total discourse moves. Four distinct conversational segments were identified. Conversational segment one contained 14 moves (30.43% of the entire conversation) and was coded *highly reflective* since 92.86% of the moves in this segment were reflective. Conversational segment two contained 15 moves (32.61% of the entire conversation) and was coded *highly directive* since 13.33% of the moves in this segment were reflective. Conversational segment three contained 11 moves (23.91% of the entire conversation) and was coded *balanced* since 45.45% of the moves in this segment were reflective. Conversational segment four contained six moves (13.04% of the entire conversation) and was coded *highly reflective* since 83.33% of the moves in this segment were reflective. Based on these counts and percentages, Figure 3.6 visually represents the number of conversational segments within this single conversation, the duration of each segment, and the intensity of a coaches' stance during the segment.

Findings

In total, 24 coaching conversations were analyzed (12 planning and 12 debriefing). From these, 1,649 discourse moves from the three coaches were identified. Findings are organized and reported separately for each of the three research questions.

Research Question One

When examining the discursive tendency of the three coaches using the frequency of the five discursive moves used by each coach, both consistency and variability were identified. As an example of a consistency, each of the three coaches was similar in their use of reflective moves (invitation and description) as the averages ranged from 31 to 36.63

reflective moves per conversation. The coaches were also consistent in their use of invitational moves. However, there existed larger variability within the coaches' use of directive coaching moves (suggestion, explanation, and evaluation). Alvarez had the lowest average of 18.5 directive moves per conversation, Bishop averaged the highest average of 59.25 directive moves per conversation, and Reiss averaged 28.25. Within the variability in the use of directive moves, the difference in the coaches' use of suggestion is noteworthy. Bishop had the highest average with 22.38 suggestions per conversations whereas Alvarez used only 3.38 suggestive moves per conversation. Bishop also had the highest level of evaluation moves with an average of 9.25 evaluations per conversation compared to Reiss who averaged only 2.63 evaluations per conversation (see Table 3.4).

Table 3.4
Average Number of Discursive Moves Per Coaching Cycle Conversation

	Reflective		Directive			Combined Reflective Moves	Combined Directive Moves
Coach	Invitation	Describe	Suggest	Explain	Evaluate		
Alvarez	25.13	7.25	3.38	11.38	3.75	32.38	18.50
Bishop	21.63	15.00	22.38	27.63	9.25	36.63	59.25
Reiss	18.63	12.38	9.38	16.25	2.63	31.00	28.25

The differences in the number of directive moves suggested the existence of variability in how the three coaches balanced the use of reflective and directive stances during the conversations. For example, Alvarez averaged 32.38 discourse moves associated with a reflective stance compared to only 18.5 moves associated with a directive stance during a single conversation. This finding suggests Alvarez favored a reflective stance. In contrast, Bishop averaged more directive moves per conversation (59.25) than reflective moves (36.63), indicating the coach favored a directive stance. The discursive moves for Reiss were more evenly balanced but implied the coach slightly favored a reflective stance.

Bishop averaged significantly more total coaching moves in a typical conversation (95.88) than both Alvarez (50.88) and Reiss (59.25). This significant difference in Bishop's average number of total discourse moves limited the comparisons of coaches' tendencies using averages since Bishop had the highest averages in four of the five discourse moves. To account for this large difference in the total discourse moves used by the coaches, percentages were used to articulate coaches' tendencies to use each discourse move. Specifically, the researcher compared the total number of instances in which a coach used a specific discourse move to the coaches' total number of discourse moves. For example, Alvarez used 407 total discourse moves during the eight coaching conversations. Of this total, 201 were coded as invitations. Thus, 49.26% of Alvarez's coaching moves were invitations (see Table 3.5).

Table 3.5
Percentage of Discursive Moves Each Coach Used during All Coaching Cycle Conversations

	Reflective			Directive		Combined Reflective Moves	Combined Directive Moves
Coach	Invitation	Describe	Suggest	Explain	Evaluate		
Alvarez	49.26%	14.22%	6.62%	22.30%	7.35%	63.48%	36.27%
Bishop	22.56%	15.65%	23.34%	28.81%	9.65%	38.20%	61.80%
Reiss	31.43%	20.89%	15.82%	27.43%	4.43%	52.32%	47.68%

The percentage of discourse moves each coach used during all coaching cycle conversations confirmed the previous findings reported using the averages. For example, Bishop had the highest percentage of directive moves (61.80%) suggesting this coach held a directive stance more frequently than the other two coaches. Similarly, Alvarez had the highest percentage of reflective moves (63.48%) suggesting this coach held a reflective stance more frequently than the other two coaches. The percentages also provided new insights into the tendencies of coaches. For example, 49.26% of Alvarez's discourse moves

were invitations which was significantly higher than the percentages for Alvarez's use of the other four discourse moves. Only 6.62% of Alvarez's moves were suggestions and only 7.35% were evaluations indicating Alvarez had a strong tendency to use invitational moves and to limit the use of suggestions and evaluations. In contrast, Bishop used three moves, explanations (28.81%), suggestions (23.34%), and invitations (22.56%), with relatively common frequency. This suggests Bishop did not tend to favor one move like Alvarez and instead preferred to use multiple. Reiss tended to use invitation (31.43%) and explanation (27.43%) moves more frequently than other moves. Reiss also tended to limit the use of evaluation as only 4.43% of this coaches' total discourse moves were coded as evaluations.

Among other tendencies, the differing averages and percentages indicated Alvarez most frequently held a reflective stance, Bishop most frequently held a directive stance, and Reiss balanced the two stances with approximately equal frequency. The analysis of the conversational segments within the 24 coaching conversations extended these claims by showing all three coaches held both reflective and directive stances during different portions of their coaching conversations. However, the frequency, duration, and intensity of the coaches' stances during these conversational segments differed greatly. Figure 3.7 provides a visual representation of this claim and displays the frequency, duration, and intensity of a coaches' stance in the coaching conversations. The intensity of the coaches' stance during a conversational segment is represented by the color of the rectangle. Recall that blue represents a highly reflective stance, light blue represents a moderately reflective stance, light green represents a balanced stance, light yellow represents a moderately directive stance, and yellow represents a highly directive stance (see Figure 3.5 for the specific details of this characterization). The duration of a conversational segment is represented by the

length of a colored rectangle relative to the length whole conversation using the number of discourse moves in a segment. For example, in the planning conversation for coaching cycle one, Alvarez held a balanced coaching stance during the first 25% of the conversation (approximately) and then switched to a moderately reflective stance during the second 75% of the conversation. The frequency of different conversational segments is represented by the number of colored rectangles. For example, during the four planning conversations, Alvarez held a moderately reflective stance during five different conversational segments represent by the five light blue rectangles in the four bars which each represent a single conversation. A description of each coaches' tendencies with respect to the frequency, duration, and intensity of their conversational segments is provided.

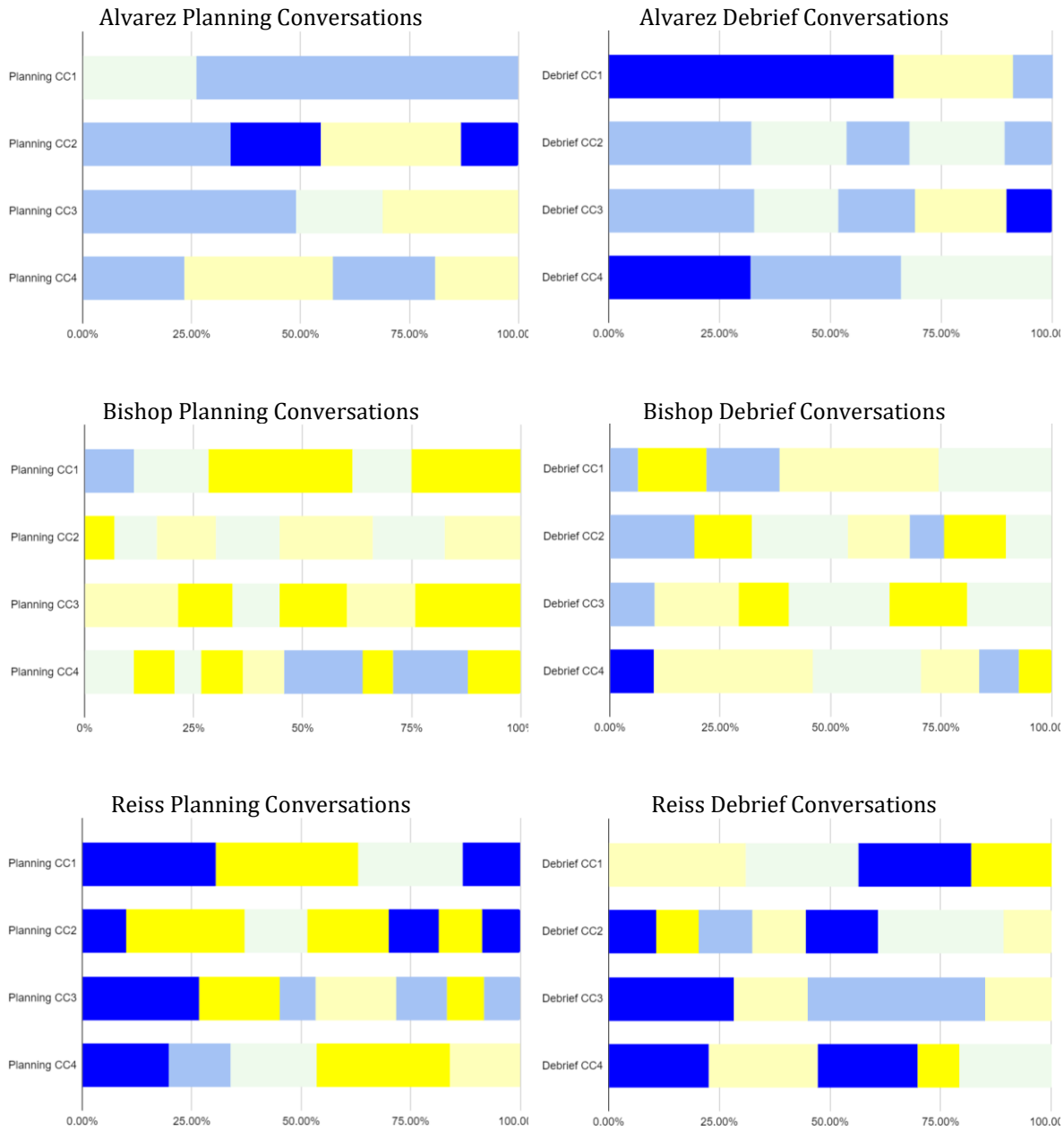

Figure 3.7. Visual displays of the conversational segments in all 24 coaching conversations.

Alvarez. Recall three key findings regarding Alvarez's discursive tendencies based on the percentages of discourse moves used during all conversations and the average number of discourse moves used per conversation. Alvarez used more reflective moves than directive moves, had the highest percentage of reflective moves when compared to the other two coaches, and strongly favored the use of invitation moves. Analysis of the

conversational segments provided four additional findings regarding Alvarez's tendencies to hold reflective and directive stances. First, Alvarez held a moderately reflective stance in the coaching conversations more often than any other of the four categories to characterize a coaches' stance. In Alvarez's eight coaching conversations, 11 conversational segments were identified as moderately reflective resulting in an average of 1.38 moderately reflective segments per conversation (see Table 3.6). When combining all conversational segments with the same stance characterization within the eight conversations, 43.24% of Alvarez's conversations were coded as moderately reflective segments (see Figure 3.8). Despite Alvarez's tendency to use more reflective moves than directive moves, this coach held a highly reflective stance less frequently than a moderately reflective stance. Only five conversational segments in the eight conversations were identified as highly directive which accounted for 18.67% of the coaches' total conversation.

Table 3.6
Summary of the Coded Stance of Conversational Segments

	Alvarez	Bishop	Reiss
	Number of Segments	Number of Segments	Number of Segments
Highly Directive	0	16	10
Moderately Directive	6	11	8
Balanced	6	14	6
Moderately Reflective	11	9	6
Highly Reflective	5	1	13
Sum	28	51	43
Average	3.5	6.38	5.38

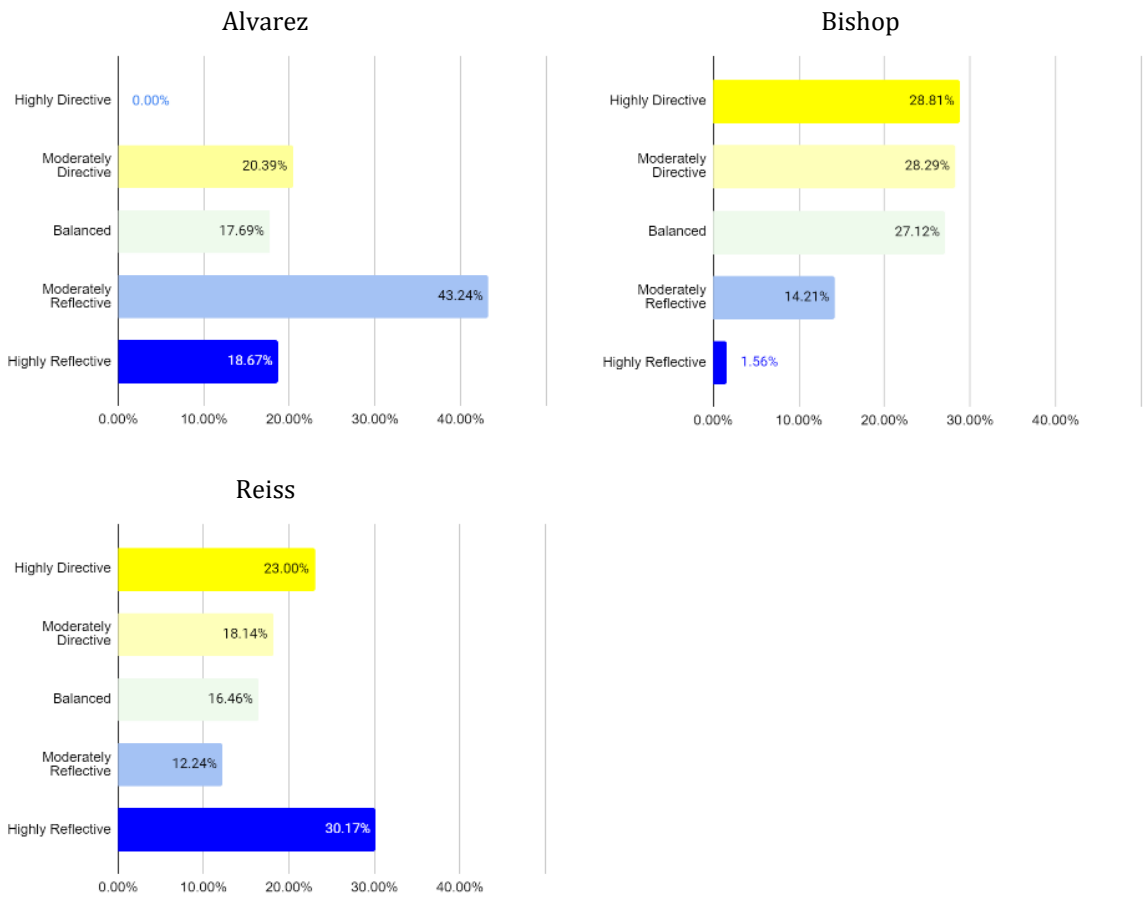

Figure 3.8. Percentage of all conversations coded as conversational segments with a particular stance.

Second, Alvarez held balanced and moderately directive stances in conversational segments, but these conversational segments were less frequent than those coded as moderately reflective. Six conversational segments were identified as balanced, accounting for 17.69% of the total conversations and six conversational segments were identified as moderately directive, accounting for 20.39% of the total conversation. This indicated that despite Alvarez's tendency to use more reflective moves than directive moves, there existed conversational segments in which the coach shifted out of reflective stances. Furthermore, in all eight conversations, Alvarez used either a balanced or moderately directive stance. In five of the eight conversations, Alvarez held a moderately directive stance. However, Alvarez never held a highly directive stance.

Third, the researcher identified patterns with respect to when Alvarez held certain stances within the conversations. For example, Alvarez tended to begin conversations holding a reflective stance (moderately or highly). In seven of the eight conversations, Alvarez held a reflective stance for at least the first 25% of the conversation (approximately). If Alvarez used a moderately directive stance, it was typically during the second half of the conversations. In only one conversation did Alvarez use a moderately directive stance within the first 50% of the conversation.

As a fourth and finally tendency, Alvarez changed stances fewer times during conversations than the other two coaches. Twenty-eight conversational segments were identified in Alvarez's eight conversations resulting in an average of 3.5 conversational segments per conversation. Thus, Alvarez typically changed stances two to three times per conversation. This tendency will be discussed further within the descriptions of the other two coaches' tendencies.

To illustrate Alvarez's tendency to hold a moderately reflective stance, begin conversations with a reflective stance, and favor the use of invitational moves, Figure 3.9 shows two conversational segments from Alvarez's first 29 discourse moves during the planning conversation in coaching cycle two.

Cycle	Conv.	#	Move	Stanza
2	Plan	1	invitation	3
2	Plan	2	describe	4
2	Plan	3	invitation	4
2	Plan	4	invitation	5
2	Plan	5	invitation	6
2	Plan	6	explain	7
2	Plan	7	suggest	7
2	Plan	8	describe	8
2	Plan	9	explain	8
2	Plan	10	invitation	8
2	Plan	11	invitation	9
2	Plan	12	explain	10
2	Plan	13	invitation	10
2	Plan	14	describe	11
2	Plan	15	evaluate	11
2	Plan	16	invitation	11
2	Plan	17	evaluate	12
2	Plan	18	explain	12
2	Plan	19	describe	13
2	Plan	20	invitation	14
2	Plan	21	invitation	14
2	Plan	22	invitation	15
2	Plan	23	describe	15
2	Plan	24	describe	16
2	Plan	25	invitation	17
2	Plan	26	invitation	18
2	Plan	27	invitation	19
2	Plan	28	explain	20
2	Plan	29	invitation	20

Figure 3.9. Example partially illustrating Alvarez's discursive tendencies.

The first conversational segment was identified in moves one through 18. In this segment, Alvarez used 11 reflective moves (eight invitations and three descriptions) and seven directive moves (one suggestion, four explanations, and two evaluations). This segment was coded as moderately reflective since 61.11% of Alvarez's moves were reflective. The second conversational segment was identified in moves 19 through 29. In this segment,

Alvarez used 10 reflective moves (seven invitations and three descriptions) and one directive move (one explanation). This segment was coded as highly reflective since 90.91% of Alvarez's moves were reflective.

Bishop. Recall three key findings regarding Bishop's discursive tendencies based on the percentages of discourse moves used during all conversations and the average number of discourse moves used per conversation. Bishop used more directive moves than reflective moves, had the highest percentage of directive moves when compared to the other two coaches, and most commonly used suggestions, explanations, and invitational moves with similar frequency. In the 51 conversational segments identified in Bishop's eight conversations, three findings were identified. First, Bishop most frequently held a highly directive stance. Sixteen conversational segments in Bishop's eight coaching conversations were coded as highly directive resulting in an average of two highly directive segments per conversation (see Table 3.6). These highly directive segments accounted for 28.81% of the eight coaching conversations (see Figure 3.8). Bishop also used balanced and moderately directive stances with only slightly less frequency. Fourteen conversational segments, accounting for 27.12% of all conversations, were coded as a balanced stance for Bishop and 11 segments, accounting for 28.29% of all conversations, were coded as moderately directive.

Second, Bishop held reflective stances, but these conversational segments were less frequent and shorter than segments coded as highly directive, moderately directive, or balanced. Nine segments were coded as moderately reflective, and one segment was coded as highly reflective. However, the ten total reflective segments (moderate and high) accounted for only 15.77% of Bishop's total conversations. This smaller percentage was

due, in part, to Bishop's reflective segments being shorter, on average, than directive segments. For example, Bishop's moderately directive segments contained 19.7 discourse moves on average. Conversational segments coded as moderately reflective contained only 12.1 discourse moves on average.

Third, Bishop changed stances more times during conversations than the other two coaches. Fifty-one conversational segments were identified in Bishop's eight conversations resulting in an average of 6.38 conversational segments per conversation. Thus, Bishop typically changed stances five to six times per conversation.

To illustrate Bishop's tendency to hold highly directive and balanced stances, and favor the use of invitation, suggestion, and explanation moves with similar frequency, Figure 3.10 shows two conversational segments from Bishop's first 24 discourse moves during the planning conversation in coaching cycle four.

Cycle	Conv.	#	Move	Stanza
4	Plan	1	invitation	1
4	Plan	2	invitation	1
4	Plan	3	invitation	2
4	Plan	4	explain	3
4	Plan	5	invitation	4
4	Plan	6	explain	4
4	Plan	7	explain	5
4	Plan	8	explain	6
4	Plan	9	explain	7
4	Plan	10	suggest	8
4	Plan	11	invitation	9
4	Plan	12	invitation	9
4	Plan	13	invitation	9
4	Plan	14	suggest	10
4	Plan	15	suggest	10
4	Plan	16	suggest	11
4	Plan	17	explain	11
4	Plan	18	explain	11
4	Plan	19	explain	11
4	Plan	20	suggest	11
4	Plan	21	invitation	12
4	Plan	22	explain	12
4	Plan	23	evaluate	13
4	Plan	24	explain	13

Figure 3.10. Example partially illustrating Bishop's discursive tendencies.

The first conversational segment was identified in moves one through 13. In this segment, Bishop used seven reflective moves (seven invitations) and six directive moves (one suggestion and five explanations). This segment was coded as balanced since 53.85% of Bishop's moves were reflective. The second conversational segment was identified in moves 14 through 24. In this segment, Bishop used one reflective move (one invitation) and ten directive moves (four suggestions, five explanations, and one evaluation). This segment was coded as highly directive since 9.09% of Bishop's moves were reflective.

Reiss. Recall two key findings regarding Reiss's discursive tendencies based on the percentages of discourse moves used during all conversations and the average number of discourse moves used per conversation. Reiss used an approximately equal number of reflective and directive moves, and most commonly used explanation and invitation moves with similar frequency. In the 43 conversational segments identified in Reiss's eight conversations, four findings were identified. First, Reiss most frequently held a highly reflective stance. Thirteen conversational segments in the eight coaching conversations were coded as highly reflective resulting in an average of 1.63 highly reflective segments per conversation (see Table 3.6). These highly reflective segments accounted for 30.17% of the eight coaching conversations (see Figure 3.8) and all eight of Reiss's coaching conversations contained at least one highly reflective conversational segment.

Second, and in contrast to this previously described finding, Reiss's second most common stance was highly directive. Ten conversational segments, accounting for 23.00% of all conversations, were coded as highly directive for Reiss. Furthermore, seven of the eight coaching conversations included at least one conversational segment coded as highly directive. This finding, combined with the previously reported finding, indicated Reiss held either a highly reflective or highly directive stance in 53.17% of the conversations suggesting Reiss tended to use more overt coaching stances than the other two coaches.

Third, Reiss was the only coach to have a significant number of conversational segments coded with each of the five stance categories. In addition to the presence of highly directive and highly reflective segments, eight segments were coded as moderately directive, accounting for 18.14% of all conversations, six segments were coded as balanced, accounting for 16.46% of all conversations, and six segments were coded as moderately

reflective, accounting for 12.24% of all conversations. Recall that Alvarez never used a highly directive stance and only once did Bishop hold a highly reflective stance.

Fourth, Reiss tended to begin conversations holding a highly reflective stance. This trend was present in seven of the eight conversations. Reiss also tended to shift from a highly reflective stance at the start of a conversation to a directive stance (moderate or high) in the second conversational segment. This trend was present in six of the eight conversations.

To illustrate Reiss's tendency to hold both highly reflective and highly directive stances and the tendency to begin conversations with a highly reflective stance followed by a directive stance, Figure 3.11 shows two conversational segments from Reiss's first 29 discourse moves during the planning conversation in coaching cycle one.

Cycle	Conv.	#	Move	Stanza
1	Plan	1	explain	1
1	Plan	2	invitation	2
1	Plan	3	describe	3
1	Plan	4	describe	3
1	Plan	5	invitation	4
1	Plan	6	invitation	5
1	Plan	7	describe	6
1	Plan	8	describe	6
1	Plan	9	invitation	7
1	Plan	10	invitation	7
1	Plan	11	invitation	8
1	Plan	12	describe	9
1	Plan	13	invitation	9
1	Plan	14	describe	10
1	Plan	15	suggest	10
1	Plan	16	suggest	10
1	Plan	17	explain	11
1	Plan	18	explain	12
1	Plan	19	suggest	12
1	Plan	20	explain	13
1	Plan	21	invitation	13
1	Plan	22	invitation	13
1	Plan	23	explain	14
1	Plan	24	suggest	14
1	Plan	25	explain	15
1	Plan	26	suggest	15
1	Plan	27	suggest	15
1	Plan	28	explain	16
1	Plan	29	suggest	16

Figure 3.11. Example partially illustrating Reiss's discursive tendencies.

The first conversational segment was identified in moves one through 14. In this segment, Reiss used 13 reflective moves (seven invitations and six descriptions) and one directive move (one explanation). This segment was coded as highly reflective since 92.86% of Reiss's moves were reflective. The second conversational segment was identified in moves 15 through 29. In this segment, Reiss used two reflective moves (two invitations) and

thirteen directive moves (seven suggestions and six explanations). This segment was coded as highly directive since 13.33% of Reiss's moves were reflective.

Research Question Two

When comparing the discourse moves of the three coaches in planning conversations versus debriefing conversations, there were consistencies in the ways all three coaches shifted their discursive tendencies. First, all three coaches used more reflective moves and fewer directive moves during debriefing conversations than in planning conversations. For example, Reiss used an average of 28 reflective moves during planning conversations. During debriefing conversations, Reiss averaged 34 reflective moves per conversation. Thus, Reiss averaged six more reflective moves in debriefing conversations than in planning conversations (see Table 3.7). Reiss also averaged 3.5 less directive moves in debriefing conversations than in planning conversations. Alvarez showed the most significant increase in the use of reflective moves from planning to debriefing conversations. Alvarez averaged 9.25 more reflective moves in debriefing conversation than in planning conversations. Bishop showed the most significant decrease in the use of directive moves from planning to debriefing. Bishop averaged 16 less directive moves in debriefing conversations than in planning conversations.

Table 3.7
Change in Number of Discursive Moves Used in Debriefing Conversations Compared to Planning Conversations

	Reflective		Directive			Combined Reflective Moves	Combined Directive Moves
Coach	Invitation	Describe	Suggest	Explain	Evaluate		
Alvarez	1.75	7.5	-1.75	-0.25	1	9.25	-1
Bishop	-5.25	8	-14.75	-4.25	3	2.75	-16
Reiss	-3.25	9.25	-5.25	-2	3.75	6	-3.5

The three coaches also showed similar changes in their use of discourse moves that accounted for the increase in reflective moves and decrease in directive moves. For example, all three coaches averaged at least 7.5 more description moves in the debriefing conversations than in the planning conversations. All three coaches also averaged fewer suggestions and explanations during debriefing conversations. Bishop had the largest change in the use of suggestions and average 14.75 fewer suggestions in debriefing conversations than in the planning conversations. In contrast to the overarching finding regarding the coaches using less directive moves in debriefing conversations, all three coaches averaged more evaluation moves in the debriefing conversations than in the planning conversations.

While each coach used more reflective moves and fewer directive moves during debrief conversations, the three coaches still maintained their comparative relationship with respect to the percentage of their moves coded as directive and reflective. For example, Alvarez had the highest percentage of reflective moves (59.36%) and the lowest percentage of directive moves (40.64%) in planning conversations when compared to the other two coaches. During debriefing conversations, Alvarez retained the highest percentage of reflective moves (67.27%) and the lowest percentage of directive moves (32.73%) (see Table 3.8). Similarly, Bishop used a greater percentage of directive moves than reflective moves in both planning and debriefing conversations. Specifically, 34.39% of Bishop's total moves during planning conversations were reflective and 65.61% were directive. During debriefing conversations, 42.36% of Bishop's total moves were reflective and 57.42% were directive. This finding suggests that each coach shifted their tendencies from planning to debriefing conversations but also maintained overall tendencies with respect to their use of

directive and reflective discourse moves. This claim will be further examined for each coach using the conversational segments during planning and debriefing conversations.

Table 3.8
Percentage of Discourse Moves Coded as Reflective and Directive during Planning and Debriefing Conversations

	Planning		Debriefing	
	Reflective	Directive	Reflective	Directive
Alvarez	59.36%	40.64%	67.27%	32.73%
Bishop	34.39%	65.61%	32.73%	57.42%
Reiss	52.32%	47.68%	56.20%	43.80%

When comparing the stances within conversational segments in planning and debriefing conversations, all coaches shifted towards more reflective and less directive stances. However, coaches retained certain discursive tendencies from planning to debriefing conversations. For example, in both planning and debriefing conversations, Alvarez most commonly held a moderately reflective stance (see Figure 3.12). In Alvarez's debriefing conversations, however, a smaller percentage of the conversations contained segments coded as moderately directive. In planning conversations, 29.95% of the conversations were segments coded as moderately directive while in debriefing conversations this percentage dropped to 12.27%. The oppositive was found for the percentage of conversational segments coded as balanced or highly reflective. From planning to debriefing, these percentage rose from 10.70% to 23.64% and 9.63% to 26.63% respectively.

For Bishop, directives stances were most prevalent in both planning and debriefing conversations. However, in planning conversations, highly directive conversational segments made up the largest percentage of conversations (38.05%). In Bishop's debriefing conversations, the percentage of highly directive segments dropped to 18.21%, moderately

directive segments made up the largest percentage of conversations (31.93%), and balanced segments made up the second largest percentage (30.25%). Thus, Bishop still exhibited strong tendencies to hold directive stances in both planning and debriefing conversations but shifted away from highly directive stances in planning conversations to more moderately directive and balanced stances during debriefing conversations.

Reiss exhibited a shift in stances from planning to debriefing conversations similar to Bishop. In planning conversations, Reiss strongly favored the use of a highly directive stance. 37.50% of all planning conversations were segments coded as highly directive. In debriefing conversations, a highly directive stance became the least frequent stance for Reiss (9.09%) and the use of a moderately directive stance became more frequent (27.27%). Reiss still exhibited strong tendencies to hold highly reflective stances in both planning and debriefing conversations. However, like Bishop, Reiss shifted away from a highly directive stance in planning conversations to more moderately directive and balanced stances during debriefing conversations.

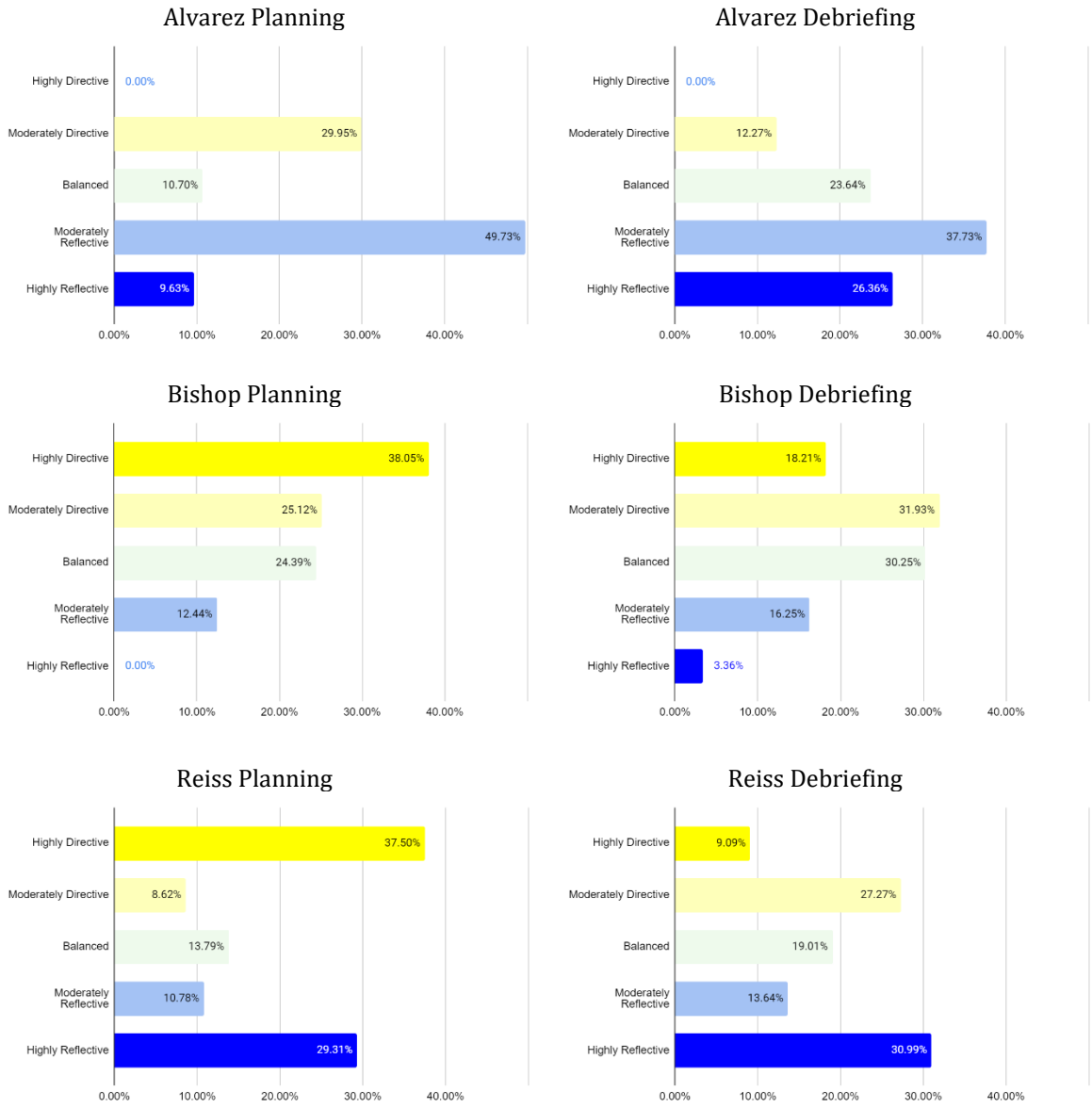

Figure 3.12. Percentage of planning and debriefing conversations coded as conversational segments with a particular stance.

There was also a pattern with respect to the stance in the first two conversational segments of debriefing conversations for all three coaches. In eleven of the 12 conversations, coaches began the conversation holding a reflective stance (moderate or high). Then, in the second conversational segment, they shift toward a less reflective and more directive stance (see Figure 3.7). For example, in each of Bishop's four debriefing

conversations, the first conversational segment was reflective (moderate or high) and the second segment was directive (moderate or high). In three of Reiss's four debriefing conversations, the first conversational segment was highly reflective and the second segment was directive (moderate or high). For Alvarez, all four conversations followed this trend but the shift from the first to the second conversational segment was less dramatic. In two debriefing conversations, the first segment was moderately reflective and the second segment was balanced. In Alvarez's other two debriefing conversations, the first segment was highly reflective, but the second segment was moderately directive in one and moderately reflective in the other. This trend suggests that all three coaches provided their teachers with opportunities at the beginning of the debriefing conversation to share their thinking before using a greater percentage of discourse moves to share their own thinking in the second segment.

Within this common trend, however, there were differences in the length of the first reflective segments. For Alvarez, the first reflective segment made up approximately 30% of the total conversation in three of the four conversations and greater than 60% for one of the conversations. The duration of these opening reflective segments for Alvarez was significantly longer than Bishop and Reiss. For Bishop, the first reflective segments made up less than 12% of the total conversation in three of the four conversations. Thus, each of the teachers was provided an opportunity to share their thinking at the start of the debrief conversations. However, the findings suggest that the teachers paired with Alvarez had a larger percentage of the conversation to share their thinking prior to the coach shifting towards less reflective and more directive coaching stances than the teachers paired with Bishop and Reiss.

Research Question Three

To analyze changes in the discursive tendencies of the three coaches across multiple coaching cycles, the researcher first examined the percentage of reflective and directive moves for each coach during successive planning conversations and then during successive debriefing conversations (see Figure 3.13). Based on this initial analysis, the researcher was unable to find trends common to all three coaches. However, trends in individual coaches' tendencies across the four cycles were identified. The absence of any trends common to all three coaches suggests that variables such as, but not limited to, the changing content of the lessons, the preparedness of the teacher upon entering the conversations, and the developing relationship between the coach and teacher may have influenced the discursive actions of the coaches but did not do so in uniform ways.

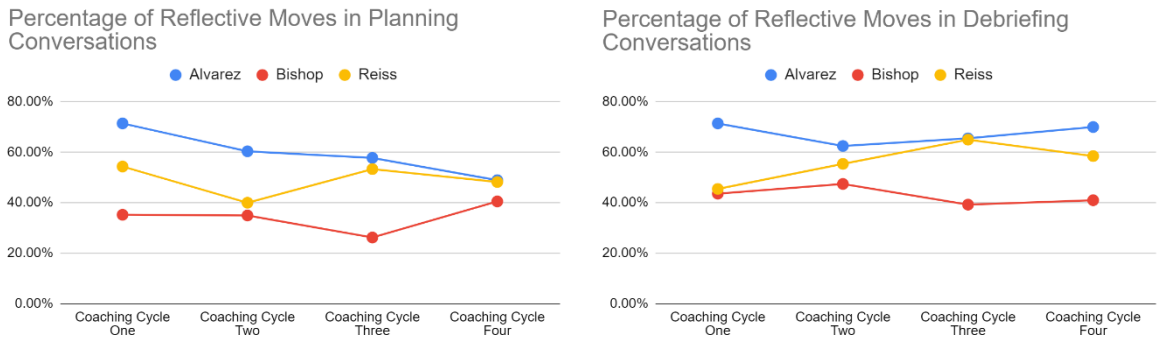

Figure 3.13. Percentage of reflective moves used across the four coaching cycles within planning and debriefing conversations.

Two tendencies were identified in how Reiss and Alvarez changed their discourse moves across the four coaching cycles. First, Alvarez's discourse moves became increasingly directive across each of the four planning conversations. In the planning conversation for coaching cycle one, 28.57% of Alvarez's moves were directive. In the planning conversations for coaching cycle four, 51.06% of Alvarez's moves were directive (see Table 3.9). The increasing percentage of directive moves was due, in part, to Alvarez's

increasing use of suggestions and decreasing use of invitations. The percentage of discourse moves coded as suggestion for Alvarez went from 4.76% (2 suggestions out of 42 total moves) in the planning conversation in coaching cycle one to 17.02% (8 suggestions out of 47 moves) in coaching cycle four. In each successive planning conversation, Alvarez used a greater number of suggestions. The increase in the percentage of directive moves was also caused by Alvarez's decreasing use of invitation moves across the four planning conversations. The percentage of discourse moves coded as invitation for Alvarez went from 66.67% (28 invitations out of 42 total moves) in the planning conversation in coaching cycle one to 46.81% (22 invitations out of 47 moves) in coaching cycle four.

Table 3.9
Percentage of Discursive Moves (and the Total Number of Moves) Used by Alvarez during Each Planning Conversation

	Reflective		Directive			Combined Reflective Moves	Combined Directive Moves
Conversation	Invitation	Describe	Suggest	Explain	Evaluate		
Planning: Cycle One	66.67% (28)	4.76% (2)	4.76% (2)	21.43% (9)	2.38% (1)	71.43% (30)	28.57% (12)
Planning: Cycle Two	49.06% (26)	11.32% (6)	5.66% (3)	24.53% (13)	9.43% (5)	60.38% (32)	39.62% (21)
Planning: Cycle Three	46.67% (21)	11.11% (5)	8.89% (4)	20.00% (9)	13.33% (6)	57.78% (26)	42.22% (19)
Planning: Cycle Four	46.81% (22)	2.13% (1)	17.02% (8)	31.91% (15)	2.13% (1)	48.94% (23)	51.06% (24)

As a second identified tendency, Reiss's percentage of reflective discourse moves increased across each of the four debriefing conversations. In the debriefing conversation for coaching cycle one, 45.45% of Reiss's moves were reflective. In the debriefing conversation for coaching cycle three, 65.00% of Reiss's moves were reflective. This percentage of reflective moves dropped slightly during coaching cycle four (58.49%). The trend was not

caused by a consistent increase in reflective moves as no pattern was identified in Reiss's use of invitations or descriptions across the four debriefing conversations. Instead, Reiss used less suggestions and explanations across the four debriefing conversations (see Table 3.10). The percentage of Reiss's suggestive moves dropped steadily across all four conversations from 20.00% (11 suggestions in 55 total moves) in coaching cycle one to 3.77% (2 suggestions in 53 moves) in coaching cycle four. Similarly, the percentage of Reiss's explanation moves dropped steadily across all four conversations from 32.73% (18 out of 55) in coaching cycle one to 18.87% in coaching cycle four (10 explanations in 53 moves).

Table 3.10
Percentage of Discursive Moves (and the Total Number of Moves) Used by Reiss during Each Debriefing Conversation

	Reflective			Directive		Combined Reflective Moves	Combined Directive Moves
Conversation	Invitation	Describe	Suggest	Explain	Evaluate		
Debrief: Cycle One	18.18% (10)	27.27% (15)	20.00% (11)	32.73% (18)	1.82% (1)	45.45% (25)	54.55% (30)
Debrief: Cycle Two	32.43% (24)	22.97% (17)	13.51% (10)	25.68% (19)	5.41% (4)	55.41% (41)	44.59% (33)
Debrief: Cycle Three	35.00% (21)	30.00% (18)	6.67% (4)	23.33% (14)	5.00% (3)	65.00% (39)	35.00% (21)
Debrief: Cycle Four	24.53% (13)	33.96% (18)	3.77% (2)	18.87% (10)	18.87% (10)	58.49% (31)	41.51% (22)

These different trends for Reiss and Alvarez across the four coaching cycles suggest that one or more variables within the context of the individual conversations or coaching cycle were influencing the coaches' discursive tendencies. However, because the two trends were unique to a specific coach and no trends were found for Bishop, no generalizable claims can be made about how the discursive tendencies of mathematics coaches changed

across multiple coaching conversations with the same teacher.

Despite the absence of a trend common to all three coaches, this analysis process revealed one additional and important finding. Even though Alvarez's percentage of reflective moves decreased across the four planning conversations, Reiss's percentage of reflective moves increased across the four debriefing conversations, and all three coaches' percentage of reflective and directive moves fluctuated across all conversations, the coaches maintained their comparative relationship to each other with respect to their percentage of reflective and directive moves in all eight conversations. In other words, Alvarez used the highest percentage of reflective moves and lowest percentage of directive moves in all eight conversations. Bishop used the highest percentage of directive moves and lowest percentage of reflective moves in all eight conversations. Reiss's percentage of reflective and directive moves were always between those of Alvarez and Bishop. This finding is significant as it suggests that variables specific to an individual conversation and coaching cycle (e.g., the content and task of a lesson) can influence the discursive tendencies of coaches but do not dramatically change these tendencies.

Discussion

The purpose of this study was to examine the variability in how mathematics coaches talked with teachers during coaching cycle conversations. Generating new knowledge about the discursive tendencies of mathematics coaches was motivated by two ideas from existing coaching literature. First, prominent coaching models within mathematics education have provided different, and often conflicting, directives regarding the use of discourse moves and coaching stances when interacting with mathematics teachers (NCSM, 2019). Second, researchers have claimed a coaches' discursive tendencies and stance within coaching

conversations can impact teachers' learning experiences (e.g., Coburn & Woulfin, 2012; Costa & Garmston, 2016; Heineke, 2013). Thus, the three research questions in this study examined the discursive tendencies of mathematics coaches during coaching cycle conversations and how the context of coaching conversations can influence these discursive tendencies.

Research Question One

The first research question examined the variation between mathematics coaches' discursive tendencies. The findings associated with this question described each coaches' average number of discourse moves in a typical conversation and the coaches' use of each discourse move as a percentage of their total moves. Data showed high variability across coaches with respect to their overall use of reflective and directive moves as well as their use of specific discourse moves. For example, Alvarez used significantly more reflective moves than directive moves whereas Bishop used significantly more directive moves than reflective moves. Reiss used an approximately equal number of reflective and directive moves. Alvarez also favored the use of one discourse move as approximately half of the coach's total discourse moves were coded as invitations. In contrast, Bishop tended to use three moves (suggestion, explanations, and invitations) and used these moves with approximately equal frequency.

Although all three coaches held both reflective and directive stances when talking with teachers, there existed variability in the duration, frequency, and intensity of a coaches' stance within conversational segments of full coaching conversations. For example, Reiss used a balanced number of directive and reflective discourse moves, yet data showed Reiss favored the use of more intense coaching stances by holding highly directive or highly

reflective stances in over half of the total conversations. In contrast, Alvarez favored moderate coaching stances and primarily held a moderately reflective stance during coaching conversations but also tended to use moderately directive stances. Bishop infrequently held reflective stances as approximately 85% of all conversations were coded as balanced, moderately directive, or highly directive.

Findings from the first research question contribute to existing literature on coaching in three ways. First, existing literature on mathematics coaching has highlighted variability in the actions of coaches but prior studies have focused on how coaches spend their time and the activities they use with teachers. For example, Ellington and colleagues (2017) found coaches varied in their percentage of time spent supporting teachers individually, supporting small groups of teachers, or engaging in non-coaching activities. Campbell and Griffin (2017) identified significant variability in how coaches spend their time within broad activity categories (e.g., coaching activities, personal professional development, managerial tasks, etc.) and in the specific activities within the broad categories. For example, they found high variability in amount of time coaches spent planning lessons with teachers and observing lessons. The findings from this study extend these previous claims by highlighting the variability in the actions of coaches who are operating in a similar context. The coaches engaged teachers in the same activity structure (i.e., a video-assisted coaching cycle) within the same professional development model and were guided by the same coaching model (i.e., content-focused coaching). From the systemic functional linguistics perspective, these findings suggest coaches made significantly different choices about their use of language even when facilitating coaching conversations within a similar context. For example, Alvarez average approximately three suggestions per conversation whereas Bishop average

approximately 22 suggestions per conversation.

As a second contribution, the variability in discursive actions of the coaches, when viewed through the perspective of systemic functional linguistics (e.g., Halliday, 1978), suggests that the participating teachers had different experiences and learning opportunities during the coaching cycle conversations. To illustrate this claim, consider the planning conversations from the perspective of the teachers in coaching cycle one. Teachers Graham and Marks (paired with coach Alvarez) were invited to share their thinking 28 times throughout the conversation and were offered two suggestions and nine explanations. Additionally, approximately 75% of their conversation was coded as moderately reflective suggesting the teachers were positioned as the "primary knowers" throughout most of this initial planning conversation (González & DeJarnette, 2012; Halliday & Matthiessen, 2004). In contrast, teacher Wise (paired with coach Bishop) was invited to share thinking 21 times throughout the first planning conversation and was offered 29 suggestions and 22 explanations. Approximately 12% of the conversation was coded as reflective (moderate or high) and approximately 58% of the conversation was coded as highly directive. These findings show the teacher was positioned as the "secondary knower" throughout most of the initial planning conversation.

The theory of systemic functional linguistics claims the discursive choices made by participants impact by the context of the conversation (Halliday, 1978). This context includes the relationship of the participants and the participants' perceptions about their role in the conversation (Halliday & Hasan, 1989). In the previous example, this theory implies that Bishop's frequent choices to use language that positioned herself as the primary authority influenced the conversation context differently than Alvarez's frequent choices to

use language that positioned the teachers as the primary authorities. In turn, the contexts in the conversations highlighted above, and all others in the data set, likely evolved in disparate ways because of the coaches' differing choices and resulted in unique learning experiences for each teacher.

These claims about how the verbal actions of coaches can shape the context surrounding potential learning opportunities for teachers connect to findings from studies within literacy coaching. Heineke (2013) claimed that opportunities for teachers to talk and share their thinking about their instructional practice was an important factor associated with teacher learning during conversations with a coach. However, this study was limited in its ability to characterize these reflective opportunities for teachers since most of the coaching conversations in the study were dominated by coaches. Coburn and Woulfin (2012) similarly claimed that a literacy coaches' discursive choices impacted the power relations within the coach/teacher relationship. In turn, the power relations impacted a teachers' opportunities to make sense of new pedagogical concepts. The findings from this study on the discursive tendencies of mathematic coaches cannot be used to make evaluative claims about affordances and drawbacks of coaching moves with respect to their impact on teacher learning. However, the characterizations of coaches' discursive tendencies provide preliminary evidence that teachers' experienced coaching conversations differently based on the discursive choices made by their coaches.

As a third contribution, the findings of this study connect to, extend, and challenge claims from literacy coaching literature which have documented the existence of reflective and directive coaching stances (e.g., Deussen et al., 2007). Ippolito (2010) found that coaches held both reflective and directive stances during a single conversation and

"demonstrated a clear ability to shift stances quickly and seamlessly" (p. 170). The findings from this study connect to Ippolito's claims suggesting that both literacy and mathematics coaches tend to change their coaching stances throughout a single conversation. However, findings from the conversational segments challenge Ippolito's notion that a coaches' stance can be a dichotomous classification of either reflective or directive. Instead, the findings from this study illustrated a coaches' stance within a conversational segment fell along a continuum with varying degrees of intensity and that the three coaches exhibited unique tendencies with respect to the intensity of their stance. For example, Reiss's overall use of reflective and directive moves was approximately equal suggesting the coach balanced reflective and directive stances evenly. However, Reiss's conversational segments showed a strong tendency to hold highly reflective and highly directive stances indicating the coach preferred to use a high percentage (greater than 80%) of either reflective or directive moves within a particular segment. In contrast, Alvarez tended to hold more moderate stances. In the case of moderately reflective stances, Alvarez primarily used reflective moves (between 60% and 80%) but also included a smaller percentage of directive moves (between 20% and 40%). Thus, Alvarez did not shift between purely reflective and directive stances as described by Ippolito (2010).

The findings from this study also extend Ippolito's (2010) broad claims that coaches switched stances "quickly" during conversations by providing a more detailed description of the frequency of coaches' shifting stances. With respect to frequency, Alvarez averaged 3.5 conversational segments in a typical conversation indicating this coach typically switched stances two to three times per conversation. Bishop averaged 6.38 conversational segments per conversation indicating this coached typically shifted stance at least five times in a

typical conversation. This suggests the coaches varied with respect to how frequently they shifted their coaching stance but this variation in the average number of stance shifts per conversation ranged from 2.5 to 5.38.

Research Question Two

Research question two explored how the context of a coaching conversation can influence the discursive tendencies of a coach. Although there are many variables within the specific context of each coaching conversation that might influence a coaches' use of language, research question two focused on the relationship between the goal of the conversation (e.g., planning or debriefing) and differences between the coaches' discursive tendencies. Three key findings were reported. First, all three coaches used more reflective moves and fewer directive moves during debriefing conversations than in planning conversations. Second, all three coaches used more descriptive moves and fewer suggestions and explanations in the debriefing conversations than in the planning conversations.

These two findings may seem obvious given the goal of a debriefing conversation is to reflect on the lesson implementation. However, coaches using more descriptive moves and fewer suggestions and explanations is significant as it suggests each of the three coaches enacted a coaching practice identified by the three prominent coaching models as productive in supporting teacher learning. In the instructional coaching model, Knight (2007) claimed a coaches' role in debriefing conversations is to collaboratively explore data from the lesson with the teacher. This is accomplished by sharing descriptive, low-inference data with the teacher for the teacher to reflect upon. Knight (2014) also recommended coaches should avoid "top-down" coaching moves (akin to directive moves) in which the coach uses the data to try and shape the practice of the teacher. In the cognitive coaching model, Costa and

Garmston (2016) argued a coaches' goal in a debriefing conversation is to help teachers grow their reflective capacity. They claimed this is accomplished by providing teachers with descriptive information about the lesson, both as it was planned and how it was executed, so teachers can reflect on the differences and possible reasons for these differences. Similar to Knight (2014), Costa and Garmston (2016) cautioned coaches about using directive moves during debriefing conversations since such moves could limit teachers' opportunities to grow their reflective capacity. In the content-focused coaching model, West and Cameron (2013) encouraged coaches to collect and describe evidence of student thinking to help teachers reflect on the effectiveness of the lesson by comparing low-inference descriptions of student thinking to the lesson goals.

The coaches' use of more description moves in the debrief conversations is noteworthy given this trend in the discursive tendencies of all three coaches corresponds to an alignment of the three prominent coaching models in mathematics education. In other aspects of coaching, the three models recommend coaches use different and even conflicting actions to support teacher learning. Yet a practice identified as productive by all three models, using descriptive moves during debriefing conversations, was one of the few trends common to all three coaches. This correspondence cannot be used to claim that the alignment of the coaching models caused the coaches to act in similar ways. However, it raises questions about the potential value of different coaching models providing coaches with common, high-leverage practices when working individually with teachers.

The third finding from this study was the coaches maintained their overall tendencies, relative to each other, with respect to their use of directive and reflective discourse moves in both planning and debriefing conversations. Specifically, Alvarez used

the greatest percentage of reflective moves and Bishop used the greatest percentage of directive moves in both planning and debriefing conversations relative to the other coaches. Thus, the finding suggests Alvarez was the most reflective coach in the differing contexts of both planning and debriefing conversations while Bishop was the most directive in both contexts despite using more reflective moves in the debriefing conversations. The trend of coaches shifting towards more reflective stances while also maintaining overarching tendencies was also evident in the conversational segments. For Alvarez, a greater percentage of conversational segments were coded as highly reflective in the debriefing conversations when compared to planning conversations. Thus, Alvarez's use of moderately reflective stances during planning conversations partially shifted towards highly reflective stances during debriefing conversations. For Bishop, a greater percentage of conversational segments in debriefing conversations were coded as moderately directive and a smaller percentage were coded as highly directive. Thus, even though Bishop used more reflective moves during debriefing conversations relative to planning conversations, Bishop most commonly held a moderately directive stance during debriefing conversations.

This finding suggests that the changing context of planning versus debriefing conversations influenced the choices made by the coaches but did not cause radical shifts in the overall discursive patterns of the three coaches. From the systemic functional linguistic perspective, this suggests other variables within the contexts of the coaching conversations were governing the coaches' discursive choices. Further discussion about the examination of other variables and coaches' discursive choices is found in the next section.

Research Question Three

Similar to research question two, research question three examined the relationship

between contextual variables in coaching conversations and shifts in the way the coaches talked to teachers. Specifically, this question analyzed changes in the coaches' discursive choices across multiple coaching cycle conversations. Unlike the findings from research question two, no common trends were identified for all three coaches. However, two trends were identified for Alvarez and Reiss. Alvarez used an increasing number of directive moves across the four planning conversations and Reiss used a decreasing number of directive moves across the four debriefing conversations. No other trends were identified.

Findings also revealed that despite these trends and other fluctuations in discourse move counts, the coaches maintained their comparative relationship to each other with respect to their percentage of reflective and directive moves in all eight conversations. For example, Alvarez used the highest percentage of reflective moves in all eight conversations. Bishop used the highest percentage of directive moves in all eight conversations. Reiss's percentage of reflective and directive moves were always between those of Alvarez and Bishop. This suggests variables such as, but not limited to, the changing content of the lessons, the preparedness of the teacher upon entering the conversations, and the developing relationship between the coach and teacher may have moderately influenced the discursive actions of the coaches within individual conversations but did not significantly change their overarching tendencies.

These finding relate to Collet (2012) who studied how coaches deliberately changed their discursive tendencies over multiple coaching cycles to gradually release responsibility of planning and reflecting to the teachers. Collet (2012) found that coaches intending to release responsibility to the teachers over multiple interactions provided fewer suggestions and asked more questions across coaching cycles. Reiss's decreasing use of suggestion

moves across the four debriefing conversations connects to Collet's (2012) claims. However, Alvarez's increasing use of directive moves across the four planning conversations is opposite the trends identified by Collet (2012). These findings and their connection to Collet (2012) raise important questions for mathematics coaches. Given that teachers have access to a coach for a finite number of lessons, should coaches change their discursive tendencies by using less directive and more reflective moves across coaching cycles to gradually release responsibility to teachers? Collet (2012) argued such a shift was productive as it helped teachers to continue to grow in their practice even without the direct support of their coach, yet it was not a trend found in the discursive actions of the three project coaches.

The lack of common trends in the coaches' discursive tendencies across coaching cycles also provides further evidence that the major contextual variables influencing the coaches' language choices are outside of those specific to an individual lesson or cycle. The combined findings from research questions two and three highlighted coaches' overarching discursive tendencies remained consistent across different coaching conversations suggest coaches' tendencies may stem from characteristics of the coaches, characteristics of teacher, or other variables inherent to the coach/teacher pairs. For example, the characteristics of a coach that could potentially influence their discursive tendencies may include the coaches' beliefs about their role as a coach, beliefs about teacher learning and the learning needs of their assigned teacher, or prior professional learning experiences involving coaching. If characteristics of the coach were primarily responsible for the coaches' discursive choices, each coach would have an inherent coaching style independent of other contextual variables. Alternatively, coaches' discursive choices may also have been driven by variables

associated with their teachers' such as prior experiences and knowledge, learning needs, or teaching contexts. In this case, the coaches' overarching discursive choices would be consistent across multiple coaching conversations with a single teacher but could vary significantly during conversations with other teachers. To the knowledge of the researcher, no prior studies on coaching have explored the relationship between contextual variables and the discursive choices of coaches. This lack of research will be discussed further in the implication section.

Implications

Practicing Coaches

The findings, coding scheme, and methodology for this study could support and inform the practice of mathematics coaches in several ways. First, Knight (2014) claimed that professional educators often "don't have a clear picture of what they do when they do their work" (p. 17). It is plausible that mathematics coaches, a specific type of professional educator, lack awareness of their own discursive tendencies when facilitating planning and debriefing conversations with teachers. Practicing mathematics coaches should consider the variability of the discursive tendencies of three mathematics coaches working within a similar context in this study and reflect on their own discursive tendencies. Coaches should also consider all three research questions and the associated findings as they reflect on their awareness of their own discursive tendencies. For example, the differences in the three coaches' overall percentage of reflective and directive discourse moves should help coaches to become more aware of how they balance their use of reflective and directive moves. They might also consider research question two and the changes in the discursive tendencies of the coaches from planning to debriefing conversations to become more aware of how they

adjust their discursive moves from planning to debriefing conversations.

In addition to supporting mathematics coaches to become more aware of their own tendencies, the coding scheme and methodology employed by this study could provide an analytical lens for practicing coaches to more productively notice and name coaching moves. If coupled with watching video of their own coaching conversations or the coaching conversations of others, mathematics coaches could use the five discourse moves as language to more precisely describe the discursive actions they observed in the video. Having language to notice and describe coaching moves within a coaching conversation could support more productive interpretation and evaluation of how the coaches' moves may have impacted the learning opportunities of the teacher. Watching and discussing video clips using the common language of the five discourse moves could also support more productive collaborative discussions between coaches.

Similarly, the analysis of conversational segments could provide coaches with language to more accurately notice and describe how they balance their use of reflective and directives moves and shift between different stances throughout conversations. Such language could help coaches consider the duration, frequency, and intensity of their stance within conversational segments. In turn, this could help coaches move beyond general evaluative comments such as "I feel like I was talking too much", which may lack the specificity needed to make actionable changes to practice. For example, a coach reflecting on a conversation using video might notice they held a highly directive stance during three different conversational segments that accounted for over half of the conversation. Based on this noticing, the coach might set a goal for themself to increase reflective opportunities for their teacher. To achieve this goal, the coach might use the language from this study to

intentionally incorporate more reflective moves into directive segments to achieve a more balanced or moderately directive stance.

As a final implication for practicing coaches, the researcher created the five discourse codes to be mutually exclusive labels with no assumptions about productivity in terms of supporting teacher learning. Coaches striving to identify productive coaching moves could use these five basic discourse moves as structural building blocks to describe more elaborate and nuanced coaching moves. To illustrate this possibility, Bill and Speranzo (2019) presented numerous coaching moves that they considered productive in supporting teacher learning. Coaches can understand Bill and Speranzo's coaching moves as combinations of the five discourse moves used as codes in this study. For example, Bill and Speranzo's code *mark progress* involved a coach naming an observed teacher action and explaining why this move supported student learning. As such, *mark progress* involves a coach first using a describe move followed by an explanation move in order to explain why the teacher action was productive. As a second example, their code *make connections* involved a coach supporting a teacher in thinking about the relationship between content, pedagogy, and student thinking. Successful use of this move involves a coach describing an observed teacher or student action and using invitational moves to help the teacher think about possible connections between the event and larger principles of mathematics teaching and learning. Coaches who understand the basic discursive components of more complex coaching moves may be more likely to understand the underlying structure of these moves. In turn, coaches with this understanding may be able to use complex coaching moves more responsively and flexibly as opposed to having to memorize a list of coaching moves described as productive.

Professional Development Providers

The findings from this study have several implications for professional development providers using coaching cycles within a professional learning project. First, the variability in the discursive actions of the coaches raises questions about variability within the coaches' general beliefs about the purpose of coaching and how coaching supports the larger goals of the project. It is possible that the three coaches had a coherent and consistent understanding about how their roles as coaches were situated within the larger goals of the project. If so, the variability in the coaches' discursive actions would likely be the result of the diverse learning needs of the teachers. For example, teacher Wise may have asked for or needed Bishop to use more directive moves in order to successfully implement the teaching practices presented in the online course and online teaching labs. Similarly, teachers Graham and Marks may have had more experience with the teaching practices presented in the online course and online teaching lab which allowed Alvarez to use more reflective moves. However, it is also possible that the variability in the coaches' actions were the result of differing beliefs about coaching and the role of coaching in the project.

For professional development providers, considering the source of coaches' discursive variability is important since teachers' learning experiences can be impacted by the discursive choices of the coaches. If coaches hold coherent and consistent beliefs about their role as coaches and adjust their discursive moves based on their perceptions of their teachers, the teachers' differing experiences with coaching could be attributed to their unique learning needs. However, it maybe be problematic if the variability in coaches' discursive tendencies is caused by unclear or inconsistent beliefs about the goals of coaching since the teacher's differing experiences could be the result of the coaches' unique

preferences and style.

Therefore, professional development providers who use coaching cycles in their professional development projects should take steps to clearly articulate the overarching goals of the project and the specific role of coaching in supporting teachers' learning. This articulation should include basic guidance on how coaches should balance reflective and directive coaching moves to ensure a moderate level of consistency in teachers' learning experiences. Additionally, professional development providers can create collaborative opportunities for coaches to make public, reflect on, and calibrate their beliefs about coaching. For example, project staff could collect various video clips of conversational segments featuring coaches holding diverse stances. Coaches could then collaboratively view the different video clips in small groups akin to video clubs for teachers (e.g., Sherin & van Es, 2009). During the discussions, coaches could describe observed coaching moves and evidence of teacher thinking and interpret how the stance and discourse moves of the coach impacted the thinking of the teacher. This form of professional learning may help coaches become more aware of and consistent in their use of discursive moves and their beliefs about coaching.

Future Research

These findings are also significant for the field of mathematics education as they generate new questions for future research on coaching. First, the existence of discursive variability between coaches, even within the favorable context found in this study, warrants further exploration into the underlying causes of these differences. It is possible that the diversity in coaching discourse was due to the coaches being responsive to the varying needs of the individual teacher. However, it also plausible that these differences result from

beliefs, preferences, or personal interaction styles that are inherent of the coach. Collet (2012) highlighted that literacy coaches in one context adjusted their discursive tendencies across coaching cycles but also claimed that coaching discursive patterns are often static and not adapted based on the varying learning needs of the teacher. However, research on the adaptive nature of coaching discourse is scarce within literacy coaching (Collet, 2012) and, to the knowledge of the researcher, non-existent within the specific context of mathematics coaching. To fill this gap, future analysis should use data from additional coaching cycles to compare the discursive moves of a single coach across multiple teachers.

Second, future research should examine coaches' awareness of their discursive tendencies to better understand the underlying causes of coaches' language choices during coaching conversations. This could include analyzing coaches' awareness of their discursive tendencies prior to coaching conversations and their awareness of their discursive moves when reflecting upon a coaching conversation. Such research could involve interviewing coaches prior to a coaching cycle in which coaches are invited to share their perceptions about their general discursive tendencies and anticipate the kinds of discourse moves they will use in the upcoming coaching cycle. After the coaching cycle, coaches could be interviewed again and asked to reflect on their discursive tendencies. These interview data could then be compared to findings similar to those generated by this study to determine the extent to which coaches were conscious of their discursive tendencies prior to and after the coaching cycle. Understanding coaches' awareness of their discursive tendencies would support the design of professional learning programs for coaches.

Third, future studies should build on the results from this study to examine the relationship between the discursive tendencies of coaching and teacher learning (Heineke,

2013). Although certain coaching models make claims about the affordances and drawbacks of certain types of discursive moves (e.g., Costa & Garmston, 2016), further research is needed to better understand how different discursive tendencies affect the teacher being coached. Such research could focus on the differing learning experiences of teachers whose coaches use different levels of directive and reflective moves. For example, further analysis could be conducted on the experiences of teachers such as Wise who were paired with a coach using a higher percentage of directive moves and compared to the experiences of teachers such as Graham and Marks who were assigned a coach who tended to use more reflective coaching moves. Future research should also examine teachers' experiences and learning opportunities within the different conversational segments. This research could analyze teacher participation during conversational segments with varying levels of coaching stance intensity and how teachers learning opportunities differed during the different kinds of conversational segments. This future understanding, combined with the results of this study, could provide practicing coaches with sound guidance about how to strategically balance and employ different discursive moves.

Finally, future research is needed on ways to strategically partner coaches and teachers by matching the discursive tendencies of a coach to the unique learning needs of a teacher. Current reform efforts are pushing many mathematics teachers to completely overhaul their current pedagogy and making these significant changes to practice can be difficult (Star, 2016; Tolle, 2015). A teacher's practice is a complex interaction of knowledge, skills, identities, and beliefs (Grossman et al., 2009); thus, it is possible that the learning experiences of each mathematics teacher could be maximized by pairing them with a coach with certain discursive tendencies. For example, a teacher new to teaching

mathematics might have limited content and pedagogical content knowledge. Such a teacher may benefit from a coach who tends to provide more explanations about mathematical content. Thus, future research should examine the relationship between the discursive tendencies of coaches and how different teachers respond to these tendencies so professional development providers and school administrators can more intentionally pair mathematics teachers with a coach.

Conclusion

Coaching teachers to support their mathematics instruction is a promising practice to improve pedagogical implementation and content knowledge (Campbell & Griffin, 2017). Although coaching and coaching cycles have been shown to improve teaching practices and student learning, variability within coaching has been a dominant theme in existing literature and research results involving mathematics coaching have been inconsistent (Gibbons & Cobb, 2016). Variability in coaching experience, the types of activities coaches use, and the context surrounding the coaching activities often vary dramatically (Ellington et al., 2017). This variability has been attributed to the inconsistent impact of coaching on improving teaching and learning (Campbell & Griffin, 2017). The purpose of this study was to open up an examination of coaches' discursive tendencies and to explore the variability of coaches' stances when engaging with teachers in coaching cycles, a prominent professional learning activity mathematics coaches use when working with individual teachers to improve their practice (Mudzimiri et al., 2014).

The researcher examined the existence of reflective and directive stances of three middle school mathematics coaches during their coaching cycle conversations with teachers. Specifically, the study was guided by three questions. The findings from research question

one showed that the three coaches differed substantially in their use of reflective and directive moves. The three coaches also showed different discursive tendencies with respect to their stances during conversational segments. The findings from research question two showed that all three coaches used more reflective moves and less directive moves during debriefing conversations than in planning conversations. However, the coaches maintained their overarching discursive tendencies in both planning and debriefing conversations suggesting the goals of the conversation had only a slight impact on coaches' discursive tendencies. Similarly, research question three provided further evidence that contextual factors related to the individual conversation or coaching cycle did not have a large impact on coaches' discursive tendencies since no common trends were found for the three coaches across the four coaching cycles.

Building from the variance in mathematics coaching described by Campbell and Griffin (2017), these findings expose an additional source of variability within mathematics coaching. Data from this study show that even with coaches drawing from the same coaching model within the same professional learning program, there existed considerable variability in the discursive tendencies of coaches. In describing this variability, the intent was not to evaluatively compare coaches based on how effectively they supported teacher learning. Instead, it was to investigate the coaches' discursive differences and their use of differing coaching stances which, like other forms of variability found within coaching, likely have an impact on teacher learning (Costa & Garmston, 2016). Further exploring the possible relationship between teachers experiences and coaching practices could reveal interesting insights that would provide information on how to best support both coaches and teachers.

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Chapter 4

Examining the Impact of Video Annotations on Debriefing Conversations during Video-Assisted Coaching Cycles

The use of coaching to improve the practice of mathematics teachers has become a popular professional development option in the United States (Campbell & Griffin, 2017; Ellington et al., 2017). A mathematics coach can be defined as an individual who engages directly with classroom teachers to improve instructional practice and student learning of mathematics and is knowledgeable in mathematical content, how students learn mathematics, and pedagogy related to mathematics (Campbell & Malkus, 2011; Hull et al., 2009). Within this broad definition of mathematics coaching, the specific activity of a coaching cycle has become a common strategy for coaches to support teachers in planning for, implementing, and reflecting on ambitious instructional practices (Gibbons & Cobb, 2016). A coaching cycle consists of three parts including a coach and teacher collaboratively (a) planning a lesson around specific learning outcomes for students and the use of instructional practices necessary to support student learning, (b) implementing the lesson and instructional strategies, and (c) reflecting on the success of the lesson using evidence of student learning and the teacher's use of new instructional strategies during a debrief conversation (Bengo, 2016; West & Staub, 2003).

Leaders of various coaching models (e.g., Knight, 2014) and professional development programs (e.g., Carson et al., 2019; Gregory et al., 2017; Matsumura et al., 2019) have begun experimenting with the use of video during the coaching cycle process for

two primary reasons. First, video recording the lesson implementation, when paired with synchronous planning and debriefing conversations using teleconferencing software, allow coaching cycles to occur in a fully online space (Carson et al., 2019; Matsumura et al., 2019). Online coaching cycles make coaching more accessible to teachers regardless of their physical location (Matsumura et al., 2016). Second, viewing video of one's own teaching has been shown to effectively support teachers to identify areas of improvement by providing a more accurate image of what happened during a lesson (Borko et al., 2008; Harlin, 2014; Rosaen et al., 2008; Zhang et al., 2011). By recording and viewing video of the implemented lesson prior to a debriefing conversation within a coaching cycle, a teacher and coach may have a more accurate image of classroom events allowing for more impactful teacher reflection (Carson et al., 2019; Knight, 2014). Although using video during online coaching cycles has potential benefits, few researchers have examined how *what* is noticed by a teacher and coach during the viewing of lesson video impacts the debriefing conversation.

Researchers of prior projects have also utilized technological tools allowing teachers and coaches to mark or annotate lesson video as a way to support teacher noticing and catalyze professional discourse around salient moments of the lesson (e.g., Amador, Carson, et al., 2019; Stockero et al., 2017; Walkoe, 2015). This study builds specifically upon Amador, Carson et al. (2019) which examined the annotations created by coaches and teachers while watching lesson videos asynchronously as part of online coaching cycles. Amador and colleagues characterized the annotations created by the coach and teacher based on the subject, content, specificity, and analytic stance of the annotations. However, they did

not examine the ways coaches and teachers referenced the annotations during the debriefing conversations.

Because prior research has shown debriefing an implemented lesson during coaching cycles (e.g., Kraft et al., 2018) and the use of video (e.g., Gaudin & Chaliès, 2015; Gibbons & Cobb, 2017; Gröschner et al., 2018) can generate productive discourse about practice, it is tempting to conclude that combining the two activities within a single professional development structure will have similar or improved results. However, debriefing conversations within in-person coaching cycles without video are complex events requiring a teacher and coach to make continuous decisions about which classroom events will generate productive discussion in a fixed amount of time (West & Cameron, 2013). The addition of video viewing and annotations to a coaching cycle bring additional stimuli which may offer new opportunities for growth through reflection but may also increase the cognitive load experienced by coaches and teachers (Sweller et al., 2019). Furthermore, the decisions made by a coach regarding how to facilitate coaching cycle conversations have been shown to significantly impact the learning opportunities of the teacher (Costa & Garmston, 2016; Heineke, 2013). For these reasons, combined with the growing popularity of online coaching and lack of research regarding the use of video within coaching cycles, this project provides new knowledge for mathematics education regarding how lesson video and annotations during video-assisted coaching cycles get taken up by a coach and teacher in order to support professional discourse around important classroom events during debriefing conversations. In addition to providing a foundation for future research on the relationship between video annotations and professional discourse, such knowledge is vital

to professional developers implementing online coaching activities and practicing coaches learning to use new technological tools within an existing professional learning structure.

The coaches in the study had considerable experience with in-person coaching cycles yet lacked extensive experience with video-assisted coaching cycles in an online space and the use of annotations in the coaching cycle process. Therefore, prior to the study, the researcher conjectured there may be a broad range of behaviors for how coaches and teachers made use of the annotations during the debrief conversations. Certain coach/teacher pairs may have devoted little energy towards the annotations and instead discussed lesson events using other sources (e.g., handwriting notes or memory of events) as they would in an in-person coaching cycle. Conversely, other pairs may have given the annotations greater amounts of attention during debrief discussions. Yet the coaches may have held different stances and used a variety of discursive moves with respect to how they talked about the annotations or encouraged the teacher to reference the annotation (Ippolito, 2010; Sailors & Price, 2015). It was also possible the characteristics of annotations (e.g., content, analytic stance, specificity) may have impacted the likelihood of discussion. Given these conjectured possibilities and larger goals of the study, three questions guided the study:

(1) To what extent do coaches and teachers discuss the annotations from lesson videos during debrief conversations within coaching cycles?

(2) What are the discursive moves coaches and teachers use to discuss annotations during a debrief conversation in a coaching cycle and how does the annotation reference influence the conversation direction?

(3) What annotation characteristics and coach discourse moves were associated with higher levels of teacher discourse?

Theoretical Framing

Teacher noticing has become a common construct within research on the teaching practices of mathematics teachers (Sherin et al., 2011; Star & Strickland, 2008). Teacher noticing describes an educators' ability to sift through the many events taking place within a classroom to identify important moments worthy of attention (Walkoe, 2015). The ability to notice what is important during complex classroom situations is a key characteristic of expert teachers (Berliner, 2001). In their *Learning to Notice Framework*, van Es and Sherin (2002) expanded the idea of professional noticing beyond simply identifying salient moments into three aspects: (a) identifying what is important during a teaching event; (b) reasoning about the event; and (c) making connections between this specific event and larger principles of teaching and learning. Productive teacher noticing also involves the ability to attend to and interpret student thinking so the teacher can make decisions to respond in ways that positively impact student learning (Jacobs et al., 2010; Miller, 2011).

The process of a teacher and coach viewing video of a lesson implementation and creating annotations involves identifying important events during the lesson and then producing written reflection about these moments. A teacher or coach using an annotation to make their thinking about the events in a lesson public directly corresponds to the act of professional noticing (Amador, Carson et al., 2019). Furthermore, a teacher and coach have many choices throughout the annotation process both about the events to mark as noteworthy and how they communicate their thinking about these events of interest (Mason, 2011).

Goodwin (1994) defined professional vision as "socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social

group" (p. 606). The ways in which members of a professional community discuss events within their domain shapes the development of new knowledge and actions. For Goodwin (1994), a key practice of professional vision is *highlighting* in which a member of a professional community makes a specific aspect of an observation salient using a process of marking. *Highlighting* helps important events to "stand out" allowing the event to impact the perceptions of the community and give rise to professional discourse that further shapes new knowledge and action. Sherin (2007) adopted professional vision for use within the community of mathematics education. In this context, Sherin (2007) described *selective attention* as a key subprocess of mathematics teachers' professional vision. *Selective attention* attends to how a teacher chooses to dedicate their focus given the many things happening within a single moment. In this study, the researcher examined the interaction between the *highlighted* moments (i.e., the annotations) and the *selective attention* of the teacher and coach when deciding what to discuss during the debrief conversation.

Related Literature

Coaching

The use of coaching has been shown to positively impact the beliefs and practices of mathematics teachers (e.g., Ellington et al., 2017) in addition to improving student learning outcomes in mathematics (e.g., Campbell & Malkus, 2011). These findings regarding the promise of coaching, combined with increasing expectations for student achievement (e.g., Common Core State Standards Initiative, 2010; No Child Left Behind Act, 2001), have led an increasing number of states, districts, and schools to use mathematics coaches as a professional development option to improve teaching and learning (Campbell & Griffin, 2017; Desimone & Pak, 2017). However, the rapid increase in the use of coaching without

the guidance of research-supported best-practices for coaches led to inconsistencies in how agencies implemented coaching (Blazar & Kraft, 2015; Campbell & Griffin, 2017; Denton & Hasbrouck, 2009). Numerous studies have found coaches spend their time in vastly different ways and engage teachers in a broad array of activities (e.g., Campbell & Griffin, 2017; Ellington et al., 2017; Gibbons & Cobb, 2016; Gibbons & Cobb, 2017).

In response to the variability hindering research on and consistent implementation of coaching, several models have been created to guide the actions of coaches (National Council of Supervisors of Mathematics [NCSM], 2019). The model guiding the coaching activities within this study, content-focus coaching, defines coaching as a content expert helping a teacher develop deep and flexible knowledge of the content they teach and how students learn the content (West & Staub, 2003). Building upon this definition, content-focused coaching has two primary goals: (a) increasing the teacher's knowledge of a specific content area, such as mathematics, and (b) building the teacher's knowledge of effective instructional practices related to a specific content idea through a personalized, job-embedded program (Cobb & Jackson, 2011). The primary activity used by content-focused coaches is a coaching cycle. A coaching cycle, in an in-person context, consists of three phases: (a) a planning discussion; (b) a collaborative lesson implementation; and (c) a debriefing conversation (West & Staub, 2003). The use of content-focused coaching cycles has been shown to be an effective activity for supporting teachers in transferring new learning in ways that improve their practice (e.g., Matsumura et al., 2013; Sailors & Price, 2015). However, even with the guidance of the content-focused coaching model, coaches can engage teachers in very different ways, impacting the effectiveness of coaching cycles (Sailors & Price, 2015).

Coaching Stances and Discourse Moves. One form of variability highlighted by prior research on coaching is the stance held by a coach. A coaching stance provides language to categorize coaching moves based on the underlying goal of the coach within a particular conversational moment. Because a coach holds a formal position and is often perceived as being more accomplished and knowledgeable than the teacher, the stance of the coach during a coaching conversation is important to consider as it holds implications of power (Mosley Wetzel et al., 2017). Despite the use of slightly different terminology, prior literature has described two competing coaching stances: *reflective* or *directive* (Denton & Hasbrouck, 2009; Deussen et al., 2007; Ippolito, 2010). Coaches using a *reflective* stance strive to improve teaching practices and student learning through collaborative inquiry (Ippolito, 2010). Coaching moves associated with this stance include probing questions and describing low-inference, non-evaluative observations to help teachers examine and reflect on their practice (Costa & Garmston, 2016). In contrast, a *directive* coaching stance involves the coach utilizing their expertise in order to modify a teacher's practice in a way the coach feels is productive (Denton & Hasbrouck, 2009). Discourse moves associated with a *directive* coaching stance include the use of suggestions, interpretation of events, and evaluative feedback to support teachers in implementing new teaching practices (Ippolito, 2010). Heineke (2013) suggested more research is needed to verify "how successful coaches are using their words and verbal moves during coaching discourse to support teacher learning" (p. 430).

Online Coaching

Educational institutions and professional development projects are beginning to use various technological tools to connect teachers to qualified coaches (Ermeling et al., 2015;

Israel et al., 2013). Coaching in an online space can provide teachers with more equitable access to high-quality experts regardless of their physical location; reducing the sense of isolation often described by teachers in rural areas (Butler et al., 2013; Prouty, 2009). Online coaching has been shown to be equally effective in supporting teacher learning when compared to in-person coaching (Israel et al., 2013; Kraft et al., 2018). When transferring the three components of a coaching cycle to a fully online space, advances in video conferencing technology allow for synchronous planning and debriefing discussions to be an effective replacement for in-person conversations (Carson et al., 2019; Francis & Jacobsen, 2013). However, hosting a collaborative lesson implementation, the second component of the coaching cycle, poses a larger challenge in an online space because the coach and teacher are not in the same physical location. Two strategies have been examined by prior studies for overcoming this obstacle; each having been shown to effectively support both teacher and student learning within the coaching cycle process (Matsumura et al., 2019). First, technology tools such as "bug-in-ear" audio devices paired with live lesson video via a webcam can create synchronous communication between a coach and teacher during the lesson implementation. This allows a coach to provide a teacher with in-the-moment guidance (e.g., Israel et al., 2013; Vernon-Feagans et al., 2013). A second strategy for a collaborative lesson implementation, the strategy used within this project, is for the teacher to video record the lesson planned with the coach and then both the coach and teacher asynchronously view the video prior to the debrief conversation (Gregory et al., 2017; Matsumura et al., 2019). Because this study used video in this way, prior literature about the use of video as a professional development tool was examined.

Video as a PD Tool

Video has become a common professional development tool during the past 20 years for both preservice and in-service teachers (Gaudin & Chaliès, 2015). The use of video in professional development activities has increased for several reasons. First, video provides teachers with improved access to viewing classroom events when compared to traditional in-person classroom observations (Ball & Cohen, 1999). For example, video can be viewed at any time after teaching has occurred allowing teachers to reflect on their practice outside of the act of teaching (Clarke & Hollingsworth, 2000; Sherin, 2004). Second, video can capture events that would not otherwise be observable such as conversations between students in small groups and teacher interactions with individual students (Borko et al., 2008). Therefore, video can make student thinking visible while simultaneously highlighting the nuanced actions of a teacher (Barnhart & van Es, 2015). For these reasons, Borko et al. (2008) commented that video has the "unique ability to capture the richness and complexity of classrooms" (p. 418). Third, the use of video in professional development has been shown to positively impact teachers by improving teacher motivation and interest in professional development activities (Sherin, 2004). Additionally, the use of video has been shown to improve teacher noticing by supporting teachers in becoming more specific and interpretive in their analysis of classroom events (Borko et al., 2008; Santagata, 2009; Tekkumru Kisa & Stein, 2015; van Es & Sherin, 2008; Wallin & Amador, 2019).

Video can be used in many different ways to meet a variety of professional development goals (Beisiegel et al., 2018; Gaudin & Chaliès, 2015). In this study, teachers viewed video of their own implemented lessons with the goal of deepening their reflective capacity and improving their practice. Several themes emerged when examining literature specific to

teachers analyzing videos of their own teaching. First, viewing videos of one's own teaching can create a more authentic and motivational experience than viewing videos of other teachers (Seidel et al., 2011). Second, video provides teachers with a reliable mirror to reflect on their practice (Zhang et al., 2011). Using video as a self-reflection tool allows teachers to identify aspects of their practice in need of improvement (Borko et al., 2008) by closing the gap between their impressions of the lesson generated during the process of teaching and what actually happened (Harlin, 2014; Rosaen et al., 2008). Third, repeatedly viewing video of one's own teaching supports the development of teacher cognition related to productive identification and interpretation of classroom events (Sherin & van Es, 2009; Star & Strickland, 2008). This development through video viewing enables teachers to provide specific evidence from classroom events when making claims about the effectiveness of parts of a lesson (Baecher & Kung, 2011).

Although watching video of one's own teaching has the potential to positively influence teachers in a variety of ways, background knowledge and prior experience heavily influence a teacher's ability to self-reflect using video of their own teaching (Calandra et al., 2014; Seidel et al., 2011). Therefore, watching video of one's own teaching requires greater guidance and scaffolding when compared to watching lesson videos from other sources as teachers may not readily recognize ways to improve their practice (Kleinknecht & Schneider, 2013). Therefore, professional developers must be intentional in providing guidance and feedback for teachers engaging in video-assisted reflection (Brouwer et al., 2017; Calandra et al., 2014). Studies have highlighted the effectiveness of viewing video of one's own teaching with other professional educators (e.g., van Es, 2012). Collaborative viewing, under the guidance of an experienced facilitator, can provide teachers with the

necessary scaffolding while also adding additional learning opportunities as the observations of others can enhance the reflective experience (Coles, 2013; Zhang et al., 2011). Viewing video of one's own teaching can also be supported by a supervisor, collaborating teacher, or a more experienced peer (Gaudin & Chaliès, 2015).

To provide this scaffolding and stimulate reflective conversation after viewing video of one's own teaching, coaches and professional developers have asked teachers to mark interesting moments in the lesson worthy of additional conversation (Carson et al., 2019; Choppin et al., 2020; Stockero et al., 2017; Walkoe, 2015). Prior studies involving annotations of lesson video have typically analyzed the annotations and the subsequent debriefing conversations separately in search of evidence of teacher growth as a result of an intervention (e.g., Stockero et al., 2017; Walkoe, 2015). Stockero et al. (2017) asked preservice teachers to analyze video and mark "mathematically important moments a teacher should notice during instruction" (p. 387). The video annotations were then used to provoke discussion at weekly meetings. Stockero et al. (2017) analyzed the annotations for changes over time to determine the impact of a professional learning intervention. Walkoe (2015) asked teachers to tag lesson video where they saw ''interesting student algebraic thinking'' (p. 529). She used annotations and the debriefing conversations among a group of teachers as evidence of growth resulting from a professional development project on teachers' noticing of students' algebraic reasoning. Although both studies used annotations to support teachers as they reflected on their own lesson video and hosted collaborative debriefing conversations about the lesson videos, neither study examined the ways annotations get taken up during a debriefing conversation by teachers. Furthermore, no research exists, to the knowledge of the researcher, regarding the way the annotations of both a teacher and

coach influence the debriefing conversation within the specific context of a video-assisted coaching cycle in an online space.

Video-Assisted Coaching Cycles

Despite limited research on the topic, several studies have examined different aspects of the use of video within the specific context of online coaching cycles. Matsumura et al. (2019) found online coaching cycles using video of implemented lessons supported teachers in successfully using new instructional practices learned during an online course and improved student participation during class discussions. They also claimed teachers responded positively to the coaching cycle process involving video. Gregory et al. (2017) argued video-based online coaching cycles improved student achievement, peer interactions, and teacher practices related to the reduction of racial disparities in the classrooms of participating teachers. Both researchers made claims about the impact of online coaching cycles using video on teachers and students but neither articulated the ways in which viewing video supported professional discourse between coaches and teachers within the debrief conversations. Amador, Carson et al. (2019) examined the differences in the annotations created by coaches and teachers while watching lesson video within video-assisted online coaching cycles. They found coaches were more likely than teachers to focus on students and make connections within their annotations but did not explore the ways the coaches and teachers made use of the annotations during the debrief discussion. This study builds directly off Amador, Carson et al. (2019) and explores the role of the annotations within the debriefing conversations of video-assisted online coaching cycles.

As a result, professional noticing underpins much of the activity within this study. However, the research questions did not guide the examination of the ways in which

teachers and coaches noticed classroom events through their annotations. Rather, the research questions for this study explored the ways teachers and coaches took up the recorded noticing (i.e., the annotations) during a debrief conversation. Specifically, the study focused on the decisions (conscious or subconscious) teachers and coaches made regarding how to involve the annotations in a debriefing conversation. Because this study examined the specific acts of how coaches and teachers chose to discuss annotations and not the more general actions of how they attended to all possible classroom events from the lesson video, a theoretical lens broader than teacher noticing was used to adequately frame the methodology.

Methods

This study occurred within the coaching activity of a larger, fully online, professional development project created for middle school mathematics teachers working in rural areas (Amador, Callard, et al., 2019; Choppin et al., 2015; Choppin et al., 2020). The project consisted of three parts: an online course, online teaching labs, and video-assisted online coaching cycles designed to improve teacher practices for implementing high cognitive demand tasks and facilitating mathematical discourse (Smith & Stein, 2011). Using a cohort model, 21 teachers from grades 5-8 participated in the project as part of two cohorts each lasting two-years. In the coaching cycle portion of the project, teachers were partnered with coaches using a content-focused coaching model (West & Staub, 2003).

Participants

This study focused on seven coaches (see Table 4.1) and their assigned teachers (see Table 4.2) who engaged in video-assisted coaching cycles in the professional development project. These coach/teacher pairs were selected because they completed at least three video-

assisted coaching cycles. Each coach was assigned one or two cohort teachers, with whom they each engaged in a maximum of four video-assisted coaching cycles over the course of two years. As a result, the study examined nine coach/teacher pairings. All but one of the coaches had coaching experience prior to the coaching work within the project yet only two coaches had any coaching experience in an online space prior to beginning the project. Two of the coach/teacher pairings contained two teachers matched with a single coach. In these cases, teachers shared classroom teaching assignments (i.e., coteaching) and opted to be coached together by a single coach. Data were collected from the debriefing conversations of the coach/teacher pairs in addition to the annotations created by coaches and teachers when watching the lesson video prior to the discussion.

Table 4.1
Coach Demographics

Coach	Years of Classroom Experience	Years of Coaching Experience Prior to Project	Years of Online Coaching Experience Prior to Project	Cohorts Coached
Alvarez	28	21	0	One
Bishop	28	14	1	One
Braithewhite	36	34	0	Two
Lowery	14	13	1	One
Reiss	15	< 1	0	One and Two
Hale	10	2	0	Two
Whilton	8	7	0	Two

Table 4.2
Teacher Demographics

Teacher	Course Taught during Coaching Cycle	Coach	Cohort
Fernandez	5th Grade Math	Lowery	One
Graham/Marks	7th Grade Math (co-taught)	Alvarez	One
Larson/Waters	5th Grade Math (co-taught)	Reiss	Two
Morrison	7th Grade Math	Whilton	Two
Parsons	7th Grade Math	Bishop	One
Sandoval	6th Grade Math	Reiss	One
Summers	5th Grade Math	Braithewhite	Two
Swanson	Algebra 1	Hale	Two
Wise	7th Grade Math	Bishop	One

Context: Video-Assisted Coaching Cycles

The goal of each video-assisted coaching cycle was to support participating teachers with successfully implementing new discourse practices (e.g., Smith & Stein, 2011) learned during the online course and teaching labs. Each coaching cycle followed the same structure and utilized both synchronous and asynchronous activities (see Figure 4.1). First, the coach and teacher participated in a planning discussion using video conferencing technology, Zoom, focused on a lesson proposed by the teacher. Guided by the content-focused coaching model, the primary goal of this planning meeting was to collaboratively analyze the mathematical lesson goals, the tasks used in the lesson, anticipated student thinking, and instructional practice goals for the teacher (West & Staub, 2003). This allowed the coach to co-create a high-quality lesson with the teacher while also supporting teacher learning regarding planning for the use of high cognitive demand tasks. Following the planning

meeting, the teacher video- and audio- recorded themselves teaching the lesson using Swivl technology (automated video camera and recording). After the lesson was taught, the coach and teacher asynchronously watched and annotated the lesson video. Annotations were written comments about the contents of the lesson video. The coaching cycle concluded with the coach and teacher engaging in a debrief discussion that utilized the annotations to reflect on student thinking in relation to the lesson goals as well as the teacher's personal goals for improving instructional practice. The planning and debriefing conversations typically lasted forty to sixty minutes. The debriefing conversations and the annotations created prior to the debriefing conversations are the focus of analysis for this project.

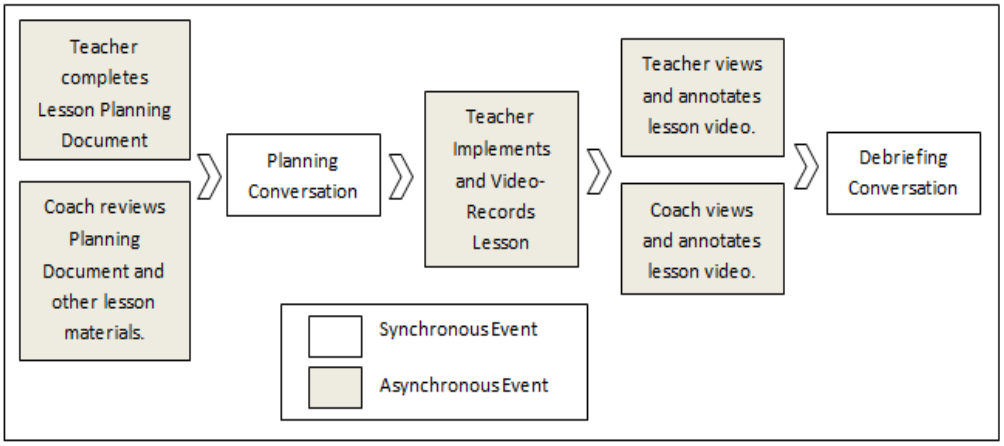

Figure 4.1. SyncOn video-assisted coaching cycle process

Context: The Annotation Process

The annotations were created asynchronously by the coach and teacher while independently viewing the lesson video. The annotations were intended to be artifacts from the lesson viewing process that would serve as catalysts for the synchronous debriefing discussion. To guide the process of annotating video, coaches and teachers were given the following prompt:

> Add your comments, questions, and thoughts to the video segment in Swivl at any points in the video that might be interesting to discuss further. For example, were

there any moments that surprised you? (i.e., misconceptions that emerged, strategies that you did not anticipate, struggles/challenges, or any “Ah-ha” moments) Were there particular instances that showed evidence of student thinking? Is there something that you see as you watch the lesson that relates to the goal you set for this coaching cycle?

To create an annotation, the coach or teacher began typing in the Swivl platform (see Figure 4.2, lower right) causing the video to pause immediately. Upon pressing enter, the video resumed. Each annotation was synced to the video using a timestamp allowing the teacher or coach to connect a comment to a specific moment in the video. In this process, the teacher always annotated the video first, followed by the coach. The coach, who viewed the video with teacher’s annotations visible, could create a new annotation generating a new timestamp for the video or could write a reply to a teacher-created annotation. The teacher did not create any additional annotations after the coach, however they were asked to review the coach’s annotations prior to the debriefing conversation.

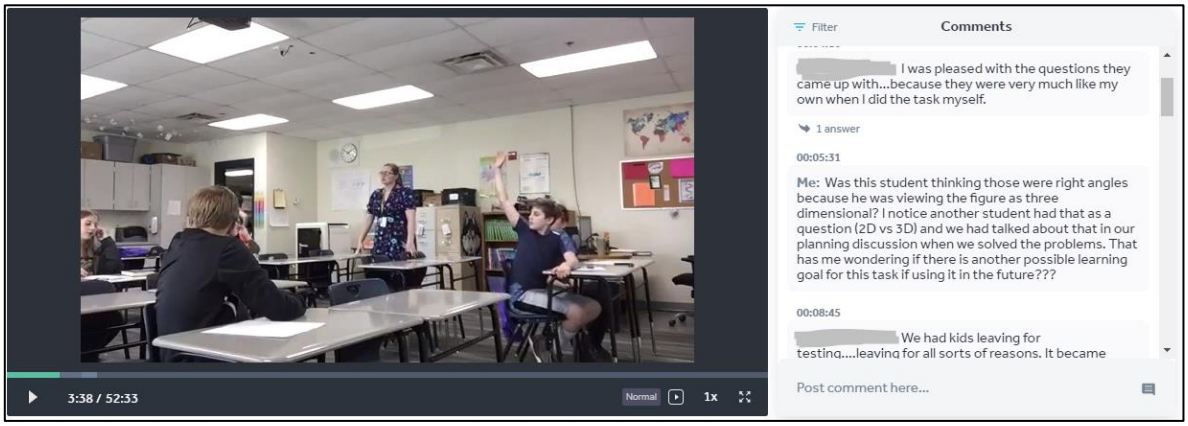

Figure 4.2. Screenshot of the Swivl platform showing the coach and teacher view of the lesson video and annotations.

Data Collected

For this study, the video annotations created by the coaches and teachers and the corresponding debriefing conversations from the third coaching cycle for each coach/teacher pair were analyzed. The third coaching cycle was selected because it allowed the teachers and coaches time to become accustomed to each other and to the video-assisted coaching process (Matsumura et al., 2016). The fourth coaching cycle was not selected as not all coach/teacher pairs completed a fourth coaching cycle and, for those who did, it was commonly reported to be a rushed experience to complete the cycle before the end of the school year. This resulted in the analysis of video annotations from nine video-recorded lessons and the nine corresponding debrief conversations. All nine debriefing conversations were video-recorded using Panopto screen-capture which recorded all activity on the coaches' computers. This allowed the researcher to view the conversation between the coach and teacher and the coach's entire computer screen, including the annotations, during all parts of the conversation. The debriefing conversations were also transcribed verbatim. Transcripts were parsed into stanzas which including the coach's discursive move and/or the teacher's discursive move about a particular topic (Saldaña, 2013). A single video annotation served as the unit of analysis.

Data Analysis

The data analysis process began with the researcher entering all annotations (copied directly from the Swivl platform) for each coach/teacher pair into separate pages within a single spreadsheet. This included the annotation text, the author of the annotation, the number of the annotation in the full set, and the timestamp connecting the annotation to a specific moment in the lesson video. Additionally, the analytic stance of all annotations had

been previously coded (see Amador, Carson et al., 2019) which characterized *how* the annotation was communicating ideas (see Figure 4.3). The analytic stance of each annotation was also copied into the spreadsheet since the researcher anticipated the annotation stance may correlate with other variables of interest in the data analysis processes. The researcher then watched the videos of the debriefing conversations from the third coaching cycles along with reading the transcriptions of the conversations. During this process, annotations were analyzed individually with respect to each research question.

Analytic Stance (How)					
Tag	Describe	Evaluate	Interpret	Suggest	Question
Identify a moment; absence of other codes	Recount or explain event or interaction	Statement with value judgement	Attach or attempt to make meaning; make sense	Offer a suggestion	Pose a question directly to other person watching video

Figure 4.3. Codebook for analyzing annotation stance, from Amador, Carson et al. (2019).

Analysis Process for Research Question One. To determine the extent coaches and teachers discussed the annotations from lesson videos during debrief conversations, two binary variables were created to code the presence of a written annotation within an instance of verbal discussion. Both variables were assigned a code of *yes* or *no* for each annotation. The first variable, *indication*, described instances when the coach or teacher clearly indicated that their verbal statement connected to a written annotation. This indication could be provided verbally or through technology features such as sharing a screen and highlighting text using the cursor. The second variable, *verbatim*, described instances when the verbal statements of the coach or teacher matched the written language in the annotation verbatim. A verbatim match included instances when spoken language exactly matched the entire annotation or a significant portion of the annotation. In instances when *indication* was coded *no* and it was debatable if a significant portion of an annotation matched a spoken

statement verbatim, the researcher used the video of conversation to consider if the annotation in question was present on the coach's screen at the same time as the spoken statement. In these ambiguous instances, if the annotation was present on the coach's screen at the time of the spoken statement, such instances were coded as *verbatim*. If the annotation was not on the coach's screen at the time of the spoken statement, such instances were coded as *not verbatim*.

An annotation was considered to have been discussed in the conversation if either *indication* or *verbatim* were coded *yes* since the presence of either variable provided a reliable indication that the written annotation was taken up in the discussion. If both *indication* and *verbatim* were coded *no*, the annotation was considered to have not been discussed in the conversation (see Figure 4.4). An annotation could have been discussed multiple times throughout a conversation. Therefore, each time the annotation was brought into the conversation, the annotation received these codes and created a new *instance of annotation discussion*.

Annotation considered present in the debriefing conversation.

Annotation considered not present in the debriefing conversation.

		Verbatim Does the spoken statement of the coach/teacher match language from the annotation verbatim?	
		Yes **(Verbatim)**	**No** **(Not Verbatim)**
Indication Does the coach/teacher clearly indicate (via spoken language or through technology features such as sharing a screen) that their verbal statement connects to an annotation?	**Yes** **(Indication)**	*Verbatim with Clear Indication*	*Not Verbatim with Clear Indication*
	No **(No Indication)**	*Verbatim with No Indication*	*Not Verbatim and No Indication*

Figure 4.4. Coding scheme for determining the presence of an annotation during debriefing conversations.

To illustrate the coding process with these two variables, two examples are provided. First, coach Alvarez created an annotation, “And what did you learn about students' understanding? How did this inform your lesson?” (shown in Figure 4.5 as it was entered into the spreadsheet prior to analysis). During the debriefing conversation, Alvarez said,

> I wondered then, again at 7:35, just what you thought about what you learned about students understanding, from the warmup, and then how that informed your lesson. Were there takeaways that you had from the warmup that made you think differently about your lesson?

Because Alvarez explicitly mentioned the timestamp of the annotation, she provided a clear indication her question was contained in the annotation. Therefore, *indication* was coded as *yes*. Alvarez also included the phrases “learned about student understanding” and “how that informed your lesson” in her verbal questions. Despite small differences in verb tense, these verbal phrases matched the written phrases within the annotation verbatim. Therefore, *verbatim* was also coded as *yes*. Since *verbatim* and *indication* were both coded *yes*, the researcher determined the annotation was present in the conversation and the instance of annotation discussion was coded as *verbatim with indication*.

Annotation #	**Time stamp**	**Author**	**Annotation**	**Annotation Stance**
3	7:35	Alvarez	And what did you learn about students' understanding? How did this inform your lesson?	Question

Figure 4.5. Example annotation created by coach Alvarez as shown in the spreadsheet.

As a second example, teacher Larson created an annotation, “Louisa - 6 on the top, 6 on the side” (shown in Figure 4.6 as it was entered into the spreadsheet prior to analysis). During the debriefing conversation, coach Reiss said, “There was a couple times too when I noticed kids talking. Somebody—let’s see. I think Louisa. She was like, ‘Six on top. Six on

side,' and you were like, 'How about we use some math words?'" In this instance, Reiss did not provide any indication her verbal statement was contained in an annotation. Therefore, *indication* was coded as *no*. However, Reiss verbally described the student's name and strategy using language that matched the annotation text verbatim. Therefore, *verbatim* was coded as *yes*. Since *verbatim* was coded *yes*, the researcher determined the annotation was present in the conversation and the instance of annotation discussion was coded as *verbatim with no indication*. During the video of this instance of annotation discussion, annotation nine was also visible on the coach's computer screen providing additional evidence that the written annotation was taken up by the coach during the conversation.

Annotation #	Time stamp	Author	Annotation	Annotation Stance
9	36:57	Larson	Louisa - 6 on the top, 6 on the side	Describe

Figure 4.6. Example annotation created by teacher Larson as shown in the spreadsheet.

If an annotation was considered to be discussed within an instance of the conversation, four additional codes were applied to each instance of annotation discussion to gain further insight into the first research question. First, to describe who initiated the conversation about the annotation, the instance received a code of *coach* or *teacher*. Second, to describe who created the annotation being discussed, the instance received a code of *coach* or *teacher*. Third, the stanza number from the transcript in which the instance of annotation discussion began was recorded. Fourth, the stanza number from the transcript in which the discussion of the annotation ended was recorded. Coding the starting and ending stanzas for an instance of annotation discussion allowed the researcher to analyze the length of discussion about an annotation and to determine when a single annotation was discussed multiple times throughout the conversation.

As an example of this coding process, coach Lowery created the annotation, “What do other people think about what he just said about using the difference of 5? His point highlights the relationship and bears repeating by another voice (preferably a peer before the teacher).” In stanza 12 of the debrief transcript, coach Lowery initiated conversation about this annotation. The discussion about the annotation continued until the end of stanza 13 when the conversation moved to a topic not contained in the annotation. In stanza 16, teacher Fernandez initiated additional conversation about this annotation which continued until the end of stanza 17. Therefore, the researcher recorded two instances of annotation discussion for this coach-created annotation; one initiated by the coach with a starting stanza of 12 and an ending stanza of 13 and the second initiated by the teacher with a starting stanza of 16 and an ending stanza of 17.

Analysis Process for Research Question Two. The second research question focused on the discursive moves teachers and coaches employed when bringing the annotation into the debriefing conversation. Additionally, this question focused on how the annotation reference influenced the conversation. The goal of analysis for this question was to identify tendencies in how coaches leveraged annotations to support professional discourse and the tendencies of teachers when reflecting on a lesson using video annotations.

Each instance of annotation discussion was assigned codes based on the discursive moves used when initiating discussion about the annotation. These codes were adapted from the coding scheme developed for examining the discourse moves of coaches in the previous project (see Table 4.3). In addition to describing the annotation when initiating conversation about the annotation, the coach or teacher could: (a) *invite* a response through a question or

statement, (b) *describe* another observed event related to the description of the annotation without providing inference or interpretation, (c) *suggest* an alternative action for the teacher for the event, (d) *explain* a potential interpretation or rationale for the event, or (e) *evaluate* the actions of the teacher or students by providing praise or critique. If the coach or teacher used multiple discursive moves not contained within the written annotation, multiple codes were applied. If the coach or teacher only restated the content of the annotation with no additional discursive moves (e.g., the coach asked the teacher the same question in the written annotation), no codes were applied.

Table 4.3
Coding Scheme for the Discursive Move Used by the Coach or Teacher after Describing the Annotation from Amador, Carson et al. (2019)

Discourse move code	Definition	Example
Invitation	Statement or question that directly invites the teacher or coach to respond after describing the annotation	"Based on the comment you made about the group of boys not participating in the whole class discussion, what might be some strategies we could have used to better support their participation?"
Description	Statement that shares a direct observation and does not contain inference, interpretation, judgement, or opinion after describing the annotation	"Based on the comment you made about the group of boys not participating in the whole class discussion, I noticed one of the boys did end up contributing an idea at the end of the discussion."
Suggestion	Statement that recommends an alternative action for the teacher after describing the annotation	"Based on the comment you made about the group of boys not participating in the whole class discussion, I think a turn-and-talk prior to the whole class discussion may have helped them to better engage in the conversation."
Explanation	Statement that provides an interpretation or rational of an event, interaction, or mathematical idea after describing the annotation	"Based on the comment you made about the group of boys not participating in the whole class discussion, I think they tuned-out because they were so confused about the task."
Evaluation	Statement that offers praise or critique after describing the annotation	"Based on the comment you made about the group of boys not participating in the whole class discussion, I think it was a great idea to use a turn-and-talk prior to the whole class discussion even though they did not participate."

To characterize how the annotation reference influenced the conversation, four codes were created based on a process of open-coding instances of annotation discussion (see Table 4.4). First, referencing an annotation could *introduce a new and unrelated topic* into the conversation. In these instances, the coach or teacher used the annotation reference to introduce a new topic into the conversation in which there was no clear connection between the new topic and the prior discussion topic. Additionally, in these instances, the speaker

provided no indication as to how this new topic was related to the prior discussion topic. For example, coach Alvarez and her teachers were talking about the affordances and drawbacks of using formal and informal mathematical language when talking with students. After talking about this topic for several stanzas, Alvarez said,

> I wondered then, again at 7:35, just what you thought about what you learned about students understanding, from the warmup, and then how that informed your lesson. Were there takeaways that you had from the warmup that made you think differently about your lesson?

In this conversation instance, the coach changed the topic from the teacher's use of language to instructional decisions made based on student understanding during the warm-up activity. Since there was no clear connection between these topics and the coach did not explain a connection, this instance was coded as *introduce a new and unrelated topic*.

Table 4.4
Coding Scheme to Characterize How the Annotation Reference Influenced the Conversation

Code	Description
Introduce a new and unrelated topic	The annotation reference introduces a new topic into the conversation but there is no clear connection between the new topic and topic being discussed previously. Additionally, the speaker provides no indication as to how this new topic is related to the prior topic being discussed.
Introduce a new and related topic	The annotation reference introduces a new topic into the conversation. There is a clear, implicit connection between the new topic introduced by the annotation reference and topic being discussed previously or the speaker explains how this new topic is related to the prior topic being discussed.
Make a connection between the current topic and an annotation	The annotation reference does not introduce new topic. Instead, the annotation reference makes a connection between the annotation and the current topic being discussed.
Advance the conversation to the next annotation in the sequence	The annotation reference advances the conversation sequentially to the next annotation in the complete list.

Second, referencing the annotation could *introduce a new and related topic* into the conversation. In these instances, there was a clear implicit connection between the new topic introduced by the annotation reference and the prior discussion topic or the speaker explains how this new topic is related to the prior discussion topic. For example, coach Reiss and teacher Sandoval were talking about instances of productive student-to-student discourse during the lesson. Reiss then asked, "Thinking about from October till now, what differences do you see in the students in their ability to listen to each other and talk with each other and question and be collaborative with each other?" (In this instance, Reiss did not provide an indication her question was in an annotation however she used language that matched text from the annotation verbatim.) This instance of annotation discussion was coded *introduce a new and related topic* since the annotation reference introduced the new topic of changes in student-to-student discourse over the school year which implicitly connects to the prior topic of instances of student-to-student discourse observed within the lesson.

Third, referencing an annotation could *make a connection between the current topic and an annotation*. In these instances, the annotation reference did not introduce a new topic but highlighted instances when the speaker articulated a connection between an annotation and the current topic being discussed. For example, coach Lowery and teacher Fernandez were talking about instructional moves to encourage students to listen to each other. Fernandez mentioned she experimented with the talk move of asking students to restate what another student had said during the lesson. After this statement, Lowery initiated conversation about an annotation by saying, "Right, because at 7:57, you did, you had asked them, in asking other people to do his thinking, put it back onto them." Through the use of

an annotation reference, the coach did not introduce a new topic. Instead, she made a connection between the current discussion topic of instructional moves to encourage students to listen to each other and an annotation highlighting the teacher's use of this instructional move. Therefore, this instance of annotation discussion was coded as *make a connection between the current topic and an annotation.*

Fourth, referencing an annotation could *advance the conversation to the next annotation in the sequence*. In these instances, the annotation reference advanced the conversation sequentially to the next annotation in the complete list. The code was applied only in cases in which there was a clear pattern of a coach or teacher repeatedly advancing the conversation to the next annotation in the sequence for a substantial portion of the debriefing conversation. This trend was triangulated using the annotations visible on the coach's screen during conversation, the language the coach or teacher used, and the order in which the annotations were discussed based on the complete list of annotations. Although instances of annotation discussion used to *advance the conversation to the next annotation in the sequence* could simultaneously influence the conversation in ways described by one of the other three codes, other codes were not applied in such cases since the ordering of the written annotations and the decision to follow this sequential order dictated the referencing of annotations.

Analysis Process for Research Question Three. Research question three aimed to find annotation characteristics and coach discourse moves associated with higher levels of teacher discourse. Understanding these associations provides valuable knowledge for coaches and professional developers tasked with using annotations to generate productive discourse during reflective discussions with teachers. A coding scheme was developed to

describe the extent a teacher talked about the ideas contained within an annotation. This coding scheme had four levels and considered the verbal contributions of the teacher related to the annotation within the start and end stanzas of the instance of annotation discussion. These verbal contributions were considered to be the sum of all the teacher's spoken talk turns about the annotation within the start and end stanzas.

The lowest level, *None,* was applied to instances of annotation discussion in which the teacher said nothing about the annotation or provided only short utterances (e.g., "uh-huh", "makes sense") in response to the coach mentioning the annotation. *Low* was applied to instances when (a) the teacher mentioned the annotation first but provided little or no additional commentary about the annotation or (b) the teacher provided minimal commentary in response to the coach mentioning an annotation. For example, coach Bishop created the annotation, "Right! It is definitely OK to disagree. I am thinking about the question 'How can you convince Trevor that your argument is correct?'" During the debriefing conversation, Bishop and teacher Parsons engaged in the following conversation about the annotation:

> Bishop: You were encouraging them to work through this disagreement, which is great. I was thinking about a question that is often useful when you have disagreements is "How can you convince the other student that your argument is correct?" This word convince is powerful in a situation like that. What does it imply the students have to do?
>
> Parsons: Mm-hmm. It implies that they have to reason with each other, reason through their own work.

After Parsons shared this statement, Bishop explained additional affordances of this instructional move and then moved the conversation on to a new annotation in the next stanza. Because Parsons only shared a single sentence related to the ideas contained in the annotation, the extent of teacher talk about the annotation was coded as *low*.

Medium was applied to instances when (a) the teacher mentioned the annotation first and provided a moderate amount of commentary about the annotation or (b) the teacher provided a moderate amount of commentary in response to the coach mentioning an annotation. For example, coach Whilton created the following annotation,

> I am thinking that the boy in the red hair is not thinking area like the boy with the blonde hair. Instead, I feel like he is thinking 6 + 6 + 4 + 4 so 75 + 75 + 73 +73.
>
> Could this be the case? If so, did the boys recognize the differences in their thinking?

During the debrief conversation, teacher Morrison shared:

> You noticed a red-haired boy and a blonde-haired boy, Edward and Brandon.
>
> Edward, the red-haired boy in the clip is like—he was doing something else, and I almost think that he was individually counting inside squares, whereas was Brandon was the one that looked at area of the inside squares. I just didn't have enough time to figure out what they were doing. I know you wrote on here, "Seeing it as six, four, and four." That could have been what he was doing. I just wasn't sure, and now that I've looked through a bunch of student work, I can't quickly remember. I'll have to pull the paper again and see what's going on with it.

After Whilton shared his interpretation of the students' thinking, Morrison responded:

> Right, yeah. I think, as a teacher, in the moment, …, I think that was listening for and not listening to, and so I was kind of, "Huh?" Yeah, it just needed a bit more—yeah

> [laughter]. It makes sense that that's what you're taking away, because I didn't know what was going on.

Within Morrison's two talk turns, she described the annotation, her confusion about the student thinking, and the interaction between her listening and ability to interpret student thinking. Each of these three ideas were communicated briefly yet combined to create a moderate amount of teacher talk about the annotation. Thus, the extent of teacher talk about the annotation was coded as *medium*.

High was applied to instances when (a) the teacher mentioned the annotation first and provided an extended amount of commentary about the annotation or (b) the teacher provided an extended amount of commentary in response to the coach mentioning an annotation. Instances coded as *high* typically involved multiple talk-turns from the teacher throughout multiple stanzas in which the teacher shared substantial thinking about the ideas contained in the annotation. Appendix A contains an annotation and portion of a debrief conversation transcript illustrating an example when the extent of teacher talk about the annotation was coded as *high*.

Coding the extent of teacher talk about an annotation allowed the researcher to separate instances of annotation discussion into four categories: *none*, *low*, *medium*, and *high*. Once all instances of annotation discussion were separated into these four categories, the researcher was able to identify variables associated with higher levels of teacher discussion about the annotations and variables associated with lower levels of teacher discussion. The same scheme was also used to code the extent of coach talk about the annotation.

Findings

In total, the researcher analyzed 308 annotations the nine coach/teacher pairs created prior to nine debriefing conversations. Of this total, coaches created 158 annotations and teachers created 150 annotations. Findings are organized and reported separately for each of the three research questions.

Research Question One

In analyzing the extent coaches and teachers talked about the annotations, the process revealed 96 of the 308 annotations created prior to the debriefing conversation were taken up in discussion resulting in an average of 10.7 annotations discussed per conversation. Because some annotations were discussed more than once during a conversation, 110 instances of annotation discussion were identified resulting in an average of 12.2 instances of annotation discussion per conversation (see Table 4.5). However, there existed variability between the coach/teacher pairs with respect to their verbal uptake of written annotations. For example, coach Braithewhite and teacher Summers had only three instances of annotation discussion about three separate annotations despite collectively creating 50 annotations prior to the conversation. Conversely, coach Bishop and teacher Parsons had 23 instances of annotation discussion about 21 separate annotations after creating 23 total annotations prior to the discussion. This suggests differences in how these coach/teacher pairs interpreted the role of the annotations during video-assisted coaching cycles. This finding also highlights a range for the number of annotations that can be discussed within a single debrief conversation.

Table 4.5
Annotation Discussion Counts by Coach/Teacher Pair

Coach/Teacher	Number of Annotations Created Prior to Debrief Discussion	Number of Annotations Discussed during Debrief Discussion	Number of Instances of Annotation Discussion
Alvarez/Graham Marks	59	11	13
Bishop/Parsons	23	21	23
Bishop/Wise	14	9	12
Braithewhite/Summers	50	3	3
Hale/Swanson	47	9	11
Lowery/Fernandez	25	11	15
Reiss/Larson Waters	27	10	10
Reiss/Sandoval	23	5	7
Whilton/Morrison	40	15	16
Average	34.2	10.7	12.2

To further examine the extent coaches and teachers talked about the annotations during debriefing conversations, the percentage of transcript stanzas containing instances of annotation discussion was calculated. The number of stanzas containing an instance of annotation discussion was divided by the total number of stanzas in the conversation. For example, the Bishop/Wise conversation transcript contained 40 stanzas. Instances of annotation discussion occurred during stanzas eight and nine and in stanzas 18 through 29. Therefore, 14 of the 40 total stanzas (35.0%) contained instances of annotation discussion. When this analysis was done for all 364 stanzas within the nine debrief conversations, 41.4% of stanzas contained an instance of annotation discussion. This finding indicated annotations were taken up in debrief conversations but were not the sole focus of conversation since less than half of the stanzas contained instances of annotation discussion. Similar variability also existed when comparing the percentage of stanzas containing instances of annotation discussion between different coach/teacher pairs. For example, in the debrief conversation transcript between coach Whilton and teacher Morrison, 62.5% of the

stanzas contained instances of annotation discussion. However, for coach Hale and teacher Swanson, only 20% of the conversation stanzas were found to have instances of annotation discussion. This suggests further differences in how coach/teacher pairs interpreted the role of the annotations during debriefing conversations (see Table 4.6 for additional detail).

Table 4.6
Instances of Annotation Discussion within Conversational Stanzas

Coach/Teacher	Total Number of Stanzas in Conversation	Number of Stanzas Containing an Instance of Annotation Discussion	Percentage of Stanzas Containing an Instance of Annotation Discussion
Alvarez/Graham Marks	37	23	62.2%
Bishop/Parsons	67	30	44.8%
Bishop/Wise	40	14	35.0%
Braithewhite/Summers	25	4	16.0%
Hale/Swanson	40	8	20.0%
Lowery/Fernandez	41	20	48.8%
Reiss/Larson Waters	43	14	32.6%
Reiss/Sandoval	31	12	38.7%
Whilton/Morrison	40	25	62.5%
Average	40.6	16.7	41.1%

Analyses for research question one also explored whether coaches or teachers were more likely to initiate conversation about the annotations. Coaches initiated conversation about the annotations more frequently than teachers. Of the 110 instances of annotation discussion, 91 (82.7%) were initiated by the coach and only 19 of the instances (17.3%) were initiated by the teacher. This finding was consistent across coach/teacher pairs as the coach initiated more than 70% of instances of annotation discussion for seven of the nine pairs.

Annotations coaches created were discussed more frequently than those teachers created even though teachers created roughly half of the annotations for the nine coach/teacher pairs. Of the 110 instances of annotation discussion, 74 (67.3%) focused on

coach-created annotations while only 36 instances (32.7%) focused on teacher-created annotations. This focus on coach-created annotations was found within instances of annotation discussion initiated by both teachers and coaches. Of the 19 instances in which teachers initiated discussion about annotations, 13 of these instances (68.4%) focused on coach-created annotations. Of the 91 instances when coaches initiated discussion about annotations, 61 of these instances (67.0%) focused on coach-created annotations. When combining the two variables about the initiator of annotation discussion and the creator of the annotation, coaches initiating conversation about coach-created annotations was the most common occurrence with 61 of the 110 (55.5%) instances of annotation discussion meeting these criteria. The least common occurrence was teachers initiating conversation about a teacher-created annotation. This occurred in only six of the 110 (5.5%) instances of annotation discussion (see Table 4.7 for additional information).

Table 4.7
Comparison of Annotation Discussion Initiation and Annotation Authorship

	Instances of Discussion about Coach-Created Annotations	Instances of Discussion about Teacher-Created Annotations	Total
Instances of Annotation Discussion Initiated by the Coach	61 (55.5%)	30 (27.3%)	91 (82.7%)
Instances of Annotation Discussion Initiated by the Teacher	13 (11.8%)	6 (5.5%)	19 (17.3%)
Total	74 (67.3%)	36 (32.7%)	110 (100%)

These findings suggest coaches were more likely to initiate conversation about the annotations and tended to discuss annotations they created. These findings highlight that coaches exerted significant influence regarding the selection of annotations to discuss and

focused on annotations containing their own ideas about the lesson. This finding may be expected given the coach's role of facilitating and catalyzing reflective discussion. However, it raises questions about *how* coaches initiated conversation about the annotations and the resulting teacher participation in the conversations about the annotations. These questions framed the findings of research questions two and three regarding the discursive moves coaches used when talking about the annotations and the extent teachers talked about the annotations.

Research Question Two

To provide context for the analysis of discourse moves used when initiating conversation about the annotations, the stances of the annotations (see Amador, Carson, et al., 2019 for additional information) that were taken up during discussion were first examined. The stance of a written annotation is akin to a discourse move in that both focus on *how* ideas are being communicated. Therefore, the stance of an annotation may associate with the discourse move used during discussion, necessitating contextual information about the stances of the annotations taken up in discussion. Of the 96 annotations discussed during the nine debrief conversations, 53 of the annotations contained a description, 47 contained a question, 30 contained a suggestion, 20 contained an evaluation, and 16 contained an interpretation. This finding highlights that annotations containing descriptions and questions were more frequently taken up in conversation than those containing evaluation and interpretation.

When analyzing the discursive moves coaches and teachers used to discuss annotations and how the annotation references influenced the conversations, findings reported for this research question focused on the actions of the coaches since 91 of the 110

instances of annotation discussion were initiated by the coach. Given this focus, several trends emerged regarding coaches' tendencies. First, coaches used a variety of discourse moves with relatively consistent frequency when initiating conversation about the annotations. In 22 of the 91 (24.2%) instances of coach-initiated annotation discussion, coaches only used the discourse move contained within the written annotation as their verbal discourse move. These cases did not receive any codes for additional discourse move. For example, coach Alvarez created the following annotation, "What was your purpose for the warm-up? What were you hoping students would gain or demonstrate an understanding of? Why was this important to the lesson?" The stance of this annotation was previously coded as *question*. During the debrief conversation, Alvarez asked the teachers:

> All right. Let's go to part two and the warm up or the bell work that you did for part two. Let me grab that. … Tell me again about your purpose now for this warmup, and what you were hoping would come out of it?

In this example of a coach initiating discussion about an annotation, Alvarez's spoken statements were fully contained within the written annotation and no additional discourse moves were used. Therefore, in these cases, the coach simply used portions of the written annotation as their full discourse move when initiating conversation about the annotation.

In 69 of the 91 (75.8%) instances of coach-initiated annotation discussion, coaches used discourse moves not contained within the written annotation. Coaches most commonly used the additional discourse move *explanation* when initiating annotation discussion. *Explanation* moves were present in 30 of the 91 (33.0%) instances of coach-initiated annotation discussion. This move involved the coach sharing additional interpretation of an event, interaction, or mathematical idea not contained in the annotation or sharing a rationale

for creating of the annotation. As an example of *explanation* as an additional discourse moves, coach Reiss created the following annotation:

> To get the students to be more collaborative, could you have them repeat or restate what their group members said? If they don't understand, they could ask a question. Could the student share their diagram on the board or show their paper to their classmates?

The stance of this annotation was previously coded as *suggestion*. During the discussion of this annotation, Reiss said:

> I think that's a way in a small group or within a whole-class discussion to get more kids involved. It's a first step in that collaborative nature for kids, because it's not high-risk. If you ask a kid to restate what somebody else said or rephrase it, that's not high-risk. If they don't know, I tell them—either ask them to repeat it again or ask them a question. Again, to get them more involved.

In this instance of initiating conversation about an annotation, Reiss referenced the suggestion in the annotation about the teacher move of asking students to restate what another student had said or ask a question. She then provided additional explanation regarding the impact of this move, explaining this move will increase student involvement in the discussion because it is not a "high-risk" situation. Because this verbal explanation was not present in the written annotation, the additional discourse move in this instance was coded as *explanation*. Suggestion was not coded as an additional discourse move because this part of the coach's verbal statement was contained in the annotation.

Coaches also used the other four discourse moves identified in the coding scheme when initiating annotation conversation. Of the 91 instances of coach-initiated annotation

discussion, 23 (25.3%) involved the coach using additional *invitational* moves, 19 (20.9%) involved the coach using additional *descriptive* moves, 10 (11.0%) involved the coach using additional *suggestive* moves, and 7 (7.7%) involved the coach using additional *evaluative* moves. This finding demonstrates coaches tended to favor the use of additional explanation about the ideas in the annotations but also used a variety of other moves with only slightly less frequency.

A second trend identified through this analysis was coaches tended to use similar discourse moves when initiating conversation about teacher-created annotations and coach-created annotations. For example, when coaches initiated conversation about teacher-created annotations, 30.0% of these instances contained an additional *explanation*. When coaches initiated conversation about coach-created annotations, 34.4% of these instances contained an additional *explanation.* Additionally, when coaches initiated conversation about teacher-created annotations, 20.0% of these instances contained an additional *description.* When coaches initiated conversation about coach-created annotations, 21.3% of these instances contained additional *description*. This trend was found for all discourse moves suggesting that there was no association between the author of the annotation and the discourse moves used by the coach when talking about the annotation.

In analyzing how the coaches' annotation references influenced the debrief conversations, two trends emerged. First, the instances of coach-initiated annotation discussion were coded relatively uniformly across the four possible categories. Of the 91 instances of coach-initiated annotation discussion, 28 instances (30.8%) involved the coach referencing the annotation to *advance the conversation to the next sequential annotation*, 25 instances (27.5%) involved the coach referencing the annotation to *introduce a new and*

unrelated topic, 19 instances (20.9%) involved the coach referencing the annotation to *make a connection between the current topic and an annotation*, and 18 instances (19.8%) involved the coach referencing the annotation to *introduce a new and related topic* (see Table 4.8).

Second, although the counts for the four codes describing how coaches used annotation references to influence the conversation were relatively uniform for the group of coaches as a whole, there existed significant variation when comparing coaches individually. For example, when talking with teachers Parsons and Wise, coach Bishop's annotations references advanced the conversation to the next sequential annotation in 28 of 35 instances (80%) of annotation discussion (see Table 4.8). This suggests Bishop favored sequential discussion of annotations. In contrast, coaches Braithewhite and Hale exclusively used annotation references to introduce a new and unrelated topic. This suggests these two coaches relied on annotations to pivot the conversations in a new direction. For coach Lowery, six of her 11 (54.5%) annotation references made a connection between the current topic and an annotation. This suggests Lowery tended to take up the annotations in discussion when they were specific instances or examples connected to the topic currently being discussed. These findings, like those from research question one, further highlight differences in how coaches interpreted the role of the annotations during debriefing conversations.

Table 4.8
Summary of How Coach-Initiated Instances of Annotation Discussion Influenced Conversations

Coach	Instances of Coach-Initiated Annotation Discussion	Number of Instances Associated with How the Annotation Reference Influenced the Conversation			
		Introduce a New and Unrelated Topic	Introduce a New and Related Topic	Make a Connection Between the Current Topic and an Annotation	Advance the Conversation to the Next Sequential Annotation
Alvarez	12	7 (58.3%)	3 (25.0%)	2 (16.7%)	0 (0%)
Bishop	35	3 (8.6%)	2 (5.7%)	2 (5.7%)	28 (80.0%)
Braithewhite	3	3 (100%)	0 (0%)	0 (0%)	0 (0%)
Hale	3	3 (100%)	0 (0%)	0 (0%)	0 (0%)
Lowery	11	4 (36.4%)	1 (9.1%)	6 (54.5%)	0 (0%)
Reiss	17	5 (29.4%)	6 (35.3%)	6 (35.3%)	0 (0%)
Whilton	10	1 (10%)	6 (60%)	3 (30%)	0%
All	91	25 (27.5%)	18 (19.8%)	19 (20.9%)	28 (30.8%)

Research Question Three

Within the 110 instances of annotation discussion, teachers tended to talk less about the annotations than coaches. Seventy-six of the instances (69.1%) were coded as *none* or *low* for the extent of teacher conversation about the annotation and 34 of these instances (30.9%) were coded as *medium* or *high*. For coaches, 60 of the instances (54.5%) were coded as *none* or *low* for the extent of coach conversation about the annotation and 50 of these instances (45.5%) were coded as *medium* or *high* (see Table 4.9 for additional detail). As an example of this coding process, coach Hale created the following annotation, “This sounds like a misconception, speed of 92 when going up but speed of -16 when going down...is she thinking this from the coefficients in the function rule? Or did she find an average rate of change?” Hale and teacher Swanson engaged in the following conversation about this annotation:

> Swanson: Uh-huh. Speed of 92. Speed of 92 when going up, it's speed of negative 16 going down. That misconception of a negative 16 when going down, I just didn't address. I was like, "I'm just going to keep going."
>
> Hale: That's a tough call. There are certainly times where you might decide a misconception is worth bringing forward to the class and addressing and working through. There might be times where it's not. I just wonder for that student, did that student leave still thinking the 92 represented the speed when it was going up because it was positive. The 16 represented the speed when it was going down because it was negative. Whereas some other students had talked about the 16 being gravity. Which I loved their answer by the way when they we were like, well some didn't know, so they went and asked another teacher.

In this instance of annotation discussion, Swanson read the coach-created annotation about a student misconception and provided a brief reflection about her instructional move. Therefore, the extent of teacher conversation about this annotation was coded as *low*. Hale shared thinking about an interpretation of the student's misconception, possible instructional moves in response to this misconception, and an additional description of student thinking. These three brief statements combined to form a moderate amount of coach conversation about the content of the annotation. Therefore, the extent of coach conversation about this annotation was coded as *medium*.

Table 4.9
Summary of the Extent of Conversation by Coaches and Teachers about the Annotations

	Extent of Conversation about an Annotation			
	None	Low	Medium	High
Teacher	25 (22.7%)	51 (46.4%)	20 (18.2%)	14 (12.7%)
Coach	4 (3.6%)	56 (50.9%)	32 (29.1%)	18 (16.4%)

Variables Positively Associated with the Extent of Teacher Conversation about the Annotations. Several individual and combinations of variables were found to have positive associations with the extent of teacher conversation about an annotation. First, instances of teacher-initiated discussion about teacher-created annotations had higher levels of teacher conversation than teacher-initiated discussion about coach-created annotations and coach-initiated discussion about annotations (see Table 4.10). For example, 66.6% of teacher-initiated instances of discussion about teacher-created annotations were coded as either medium or high for extent of teacher conversation. In contrast, only 20.0% of coach-initiated instances of discussion about the teacher-created annotations were coded as either medium or high for extent of teacher conversation. However, this finding is limited by the small number of cases of teachers initiating conversation about their own annotations.

Table 4.10
Extent of Teacher Conversation Associated with Conversation Initiation and Annotation Creation

Conversation Initiator	Annotation Creator	*n*	Extent of Teacher Conversation about the Annotation	
			None or Low	Medium or High
Coach	Coach	61	40 (65.6%)	21 (34.4%)
Coach	Teacher	30	24 (80.0%)	6 (20.0%)
Teacher	Coach	13	10 (76.9%)	3 (23.1%)
Teacher	Teacher	6	2 (33.3%)	4 (66.6%)

Second, instances of annotation discussion in which the annotation contained a question were associated with higher levels of teacher conversation than instances involving annotations that did not contain a question. Of the 56 instances of annotation discussion in which the annotation contained a question, 23 (41.1%) were coded as medium or high for the extent of teacher conversation. In contrast, of the 54 instances of annotation discussion

in which the annotation did not contain a question, only 11 (20.4%) were coded as medium or high for the extent of teacher conversation.

Third, instances of annotation discussion in which the coach used an additional invitational move when initiating conversation about the annotation had higher levels of teacher conversation than those instances without an additional invitational move from the coach. Of the 23 instances of coach-initiated annotation discussion in which the coach used an additional invitational move, 12 (52.2%) were coded as medium or high for the extent of teacher conversation. In contrast, of the 68 instances of coach-initiated annotation discussion in which the coach did not use an additional invitational move, only 15 (22.1%) were coded as medium or high for the extent of teacher conversation.

Combining the previous two findings, when coaches used an additional invitational move when initiating conversation about an annotation containing a question, teacher exhibited higher levels conversation about the annotation. In the 12 instances in which the coach used an additional invitational move when initiating conversation about an annotation containing a question, eight (66.7%) of the instances were coded as medium or high for the extent of teacher conversation. Each of these findings highlights a positive relationship between the presence of questions, either verbal or written, and the level of teacher conversation when talking about the annotations. However, the most dramatic positive association existed between the presence of both verbal *and* written questions and the level of teacher conversation when talking about the annotations.

Variables Negatively Associated with the Extent of Teacher Conversation about the Annotations. Two variables were found to have negative associations with the extent of teacher conversation about an annotation. First, instances of annotation discussion in which

the coach used an additional directive move (e.g., suggestion, explanation, or evaluation) were associated with lower levels of teacher conversation about the annotation. Of the 41 instances of coach-initiated annotation discussion in which the coach used an additional directive move when initiating conversation about the annotation, 35 (85.4%) were coded as none or low for the extent of teacher conversation. In contrast, of the 50 instances of coach-initiated annotation discussion in which the coach did not use an additional directive move, only 29 (58.0%) were coded as none or low for the extent of teacher conversation.

Second, instances of annotation discussion in which the coach or teacher used the annotation reference to *advance the conversation to the next sequential annotation* had dramatically lower levels of teacher conversation about the annotation. In the 37 instances when the coach or teacher used the annotation reference to advance the conversation to the next sequential annotation, 36 (97.3%) of the instances were coded as none or low for the extent of teacher conversation. In contrast, of the 73 instances of annotation discussion in which the coaches or teachers did not use the annotation for this purpose, only 40 (54.8%) were coded as none or low for the extent of teacher conversation. It is plausible that when discussing annotations in a sequential order, the coach and teacher have assumed a responsibility to discuss all the annotation; requiring short amounts of conversation to address all annotations in a single conversation. Given the significantly low levels of teacher conversation associated with sequential discussion, coaches may avoid discussing annotations in this manner.

Discussion

The purpose of this study was to examine how lesson video and annotations in video-assisted coaching cycles get taken up in discussion by coaches and teachers during

debriefing conversations. Even without video and annotations, debriefing conversations within in-person coaching cycles are complex events requiring a teacher and coach to make continuous decisions about selecting classroom events to discuss in a fixed amount of time (West & Cameron, 2013). The increasing popularity of adding video viewing and annotations to coaching cycles introduces additional stimuli which may support more impactful reflection but may also increase the cognitive load coaches and teachers experience (Sweller et al., 2019). Because the decisions made by a coach regarding how to facilitate coaching cycle conversations have been shown to significantly impact the learning opportunities of the teacher (Costa & Garmston, 2016; Heineke, 2013), the three research questions and corresponding analysis processes resulted in new and necessary knowledge about the use of new technological tools within an existing professional learning structure.

Research Question One

The analysis associated with the first research question examined the extent to which coaches and teachers discussed the annotations from lesson videos during debrief conversations within coaching cycles. The findings associated with this question described the number of annotations discussed and the percentage of stanzas containing instances of annotation discussion in a typical conversation. Data showed high variability across coach/teacher pairs with respect to the amount of conversation about the annotations. For example, coaches and teachers discussed, on average, approximately 11 annotations during a debriefing conversation. However, the number of annotations discussed by the nine coach/teacher pairs ranged from three to 23, indicating significant variability in the frequency in which coach/teacher pairs engaged in conversations about the annotations. Similar variability was found in the percentage of stanzas containing instances of annotation

discussion. Instances of annotation discussion were found in 41.4% of transcripts stanzas for all nine debrief conversations but these percentages ranged from 16.0% to 62.5% across the nine coach/teacher pairs. In contrast to this variability regarding the amount of discussion about annotations, two consistent trends emerged. First, coaches initiated annotation discussion more frequently than teachers across nearly all coach/teacher pairs. Additionally, coaches consistently tended to initiate conversation about annotations they created as opposed to those created by the teacher.

Findings from the first research question contribute to existing literature on coaching in three ways. First, prior studies have claimed that the use of video within coaching cycles held the potential to improve teaching practices (e.g., Gregory et al., 2017; Matsumura et al., 2019). However, prior studies did not provide any description about how the coaches and teachers took up the lesson video and annotations during conversations, leaving the actions of both coaches and teachers within the activities unknown. For professional development providers wishing to successfully implement video-assisted coaching cycles, the findings from research question one partially fill this crucial gap by highlighting a range for the number of annotations discussed within a single debrief conversation. This knowledge may support both teachers and coaches in selecting a limited number of focal annotations from a larger set when preparing for a debrief discussion. Additionally, findings about the percentage of stanzas containing annotation discussion may also support coaches and teachers to prepare for reflective discussions, which often are constrained by a limited amount of time. For example, this study revealed less than half of the stanzas contained annotation discussion for seven of the nine coach/teacher pairs. Thus, when given a fixed amount of time for a debrief conversation (commonly constrained by school logistics such

as the length of a preparation period), these findings may support coaches and teachers to set realistic goals regarding how much of their conversation could be dedicated to annotation discussion.

Second, these findings contribute to the existing literature about variability of coaching actions within coaching cycles. Prior studies have shown the actions of coaches can vary significantly when engaging teachers in conversation (e.g., Heineke, 2013; Sailors & Price, 2015). This study extends these claims about variability of coaching actions to the ways in which coaches take up annotations during debriefing conversations. The large range found in both the number of annotations discussed in the debriefing conversations and the percentage of transcript stanzas containing instances of annotation discussion suggest significant variability in the ways the coaches leveraged the annotations to catalyze discussion. This variability may be due to different interpretations about the role of the annotations to support teacher learning. For example, coach Braithewhite and teacher Summers created 50 annotations prior to the debriefing conversation. Yet, only three of these annotations were discussed and only 16% of the transcript stanzas contained instances of annotations discussion. Conversely, coach Bishop and teacher Parsons created 23 annotations prior to the debrief discussion and discussed 21 of these annotations. In this case, 44.8% of the stanzas contained instances of annotations discussion. These differences suggest coach Bishop and coach Braithewhite may have held different views about how to use the annotations to initiate productive reflective opportunities for teachers. Such differences may have significant impact on teachers because diversity in the actions of coaches has been shown to influence learning opportunities of teachers (Heineke, 2013; Sailors & Price, 2015). Although these findings cannot be directly used to make claims

about teacher learning, they do suggest teachers such as Parsons and Summers had different learning experiences when engaging in reflective discussions involving video annotations.

Third, the finding that coaches initiated more annotation discussions than teachers and the tendency of coaches to initiate conversation about their own annotations connects to claims made by Mosley Wetzel and colleagues (2017) regarding implications of power within coaching conversations. They argued a coach, or any kind of formal mentor, holds a position of power and is often perceived by the teacher as being more accomplished and knowledgeable. Thus, the actions of a coach can position a teacher as a reflective authority who co-constructs new knowledge with a colleague or as a novice mentee who depends on a coach for new knowledge. In the context of this study, a coach initiating conversation about annotations they created may be an example of coaches positioning themselves as the reflective authority since this discursive action involves the coach guiding the conversation towards moments of the lesson the coach had highlighted using an annotation.

Coaches' tendency to initiate conversation about annotations they created surfaces a tension akin to coaches positioning themselves as the authority through the use of *directive* discourse moves versus positioning the teacher as the authority through the use of a *reflective* discourse moves (e.g., Ippolito, 2010). This tension raises new questions about the power dynamics within video-assisted coaching cycles and implications of these power dynamics on teachers' learning experiences. From one perspective, a coach may have more expertise and experience than the teacher which enables the coach to highlight salient moments of the lesson and share instructional moves that may have been productive in those moments. Thus, a coach initiating conversation about coach-created annotations may effectively support teacher learning. From a competing perspective, coaches initiating

conversation about their own annotations may inadvertently position the teacher as the novice mentee within the reflective conversation. From this position, the teacher may not initiate conversation about moments from the lesson they felt were important resulting in dependency on the coach during reflective conversations. If the goal of a coaching cycle is to foster new knowledge and instructional practices that are sustained beyond the interactions with a coach, teachers may need more opportunities to initiate conversation about their own annotations and assume the position of the reflective authority. Research question three provides additional insight into this tension by considering the relationships between these variables and the amount of teacher conversation about the annotations.

Research Question Two

To further examine how coaches leveraged annotations to catalyze discussion during debrief conversations, the analysis focus of the second research question centered on the coaches' discursive moves when initiating conversation about the annotations and the different ways annotation references influenced the conversation. Four trends were found. First, annotations containing descriptions and questions were more frequently taken up in conversation than those containing evaluations and interpretations. This analysis was conducted because the stance of a written annotation is related to a discourse move in that both focus on *how* ideas are being communicated. Second, when initiating conversation about annotations, coaches favored the use of the discourse move *explanation* but used the other four discourse moves with only slightly less frequency. Third, coaches tended to use similar discourse moves when initiating conversation about teacher-created annotations and coach-created annotations. Fourth, the analysis process revealed significant variation across coaches in the ways the annotations references influenced the conversations.

The findings about variations in how coaches' annotation references influenced the conversations contribute new knowledge in two ways. First, the variability found between each of the seven coaches with respect to how they used the annotations to guide the conversation extends and supports the claims made within research question one that coaches may have had different interpretations about the role of annotations. Recall that coaches differed significantly in the numbers of annotations discussed within a single conversation. Coaches also appeared to hold different interpretations about how annotation references should be used to influence the debrief conversation. For example, coach Alvarez tended to reference annotations to introduce new and unrelated topics into the conversation. In this way, the coach seemed to use the annotations to create new conversation about ideas not yet discussed once discussion about the current topic was exhausted. Conversely, coach Whilton tended to use the annotations to introduce new ideas that were related to the topic currently being discussed. By using annotations in this way, Whilton appeared to leverage the written annotations as a tool to extend the conversation about a current topic. Data suggested coach Bishop took an entirely different approach and simply discussed the annotations in sequential order, treating the set of annotations as a conversational checklist. This highlights the potential differences in coaches' beliefs about productive ways to use written annotations to catalyze productive reflective discussion with teachers. However, additional research is needed to directly explore the connections between the coaches' discursive actions and their beliefs.

As a second contribution, this finding about variability connects to and extends existing literature regarding variability in coaching discourse patterns found in coaching conversations (e.g., Heineke, 2013; Sailors & Price, 2015). In these prior studies, researchers

focused on the diverse discourse moves and stances (e.g., reflective or directive) coaches used when facilitating one-on-one coaching conversations with teachers. The coaches' differing uses of annotations references to influence the debrief conversation detailed in this study opens a potentially new form of variability in how coaches use written artifacts from a lesson to supplement and guide the debriefing conversation. In the context of this study, the written artifacts were annotations. However, coaches engaging teachers in coaching cycles within any context will likely be creating some form of written artifacts (e.g., observation notes) to support the debrief conversation. Since prior literature (e.g., Heineke, 2013; Sailors & Price, 2015) has claimed the actions of the coach can significantly impact the learning opportunities of teachers, these findings motivate future studies to examine how coaches' use of written artifacts within debrief conversations impact teacher learning opportunities.

Findings regarding the discourse moves coaches used when initiating conversation about annotations, independent of other findings from the study, do not provide significant contributions to existing literature. These findings do, however, provide useful context for considering associations between the amount of teacher discourse about an annotation and coach discourse moves found through the analysis processes within research question three.

Research Question Three

Research question three explored the amount of teacher and coach conversation about each annotation using a coding scheme with the four levels of *none*, *low*, *medium*, or *high*. Data showed teachers tended to talk less about the annotations than coaches. However, several variables were found to have positive associations with the extent of teacher conversation about the annotations. First, instances of teacher-initiated discussion about teacher-created annotations had the greatest amount of teacher conversation when compared

to instances in which teachers initiated discussion about coach-created annotations or coaches initiated discussion about annotations. Second, instances of annotation discussion in which the annotation contained a question were associated with higher levels of teacher conversation than instances involving annotations that did not contain questions. Third, instances of annotation discussion in which the coach used an additional invitational move (e.g., a discursive move such as a question or statement that invites a response for a teacher that was not contained in the written annotation) when initiating conversation about the annotation had higher levels of teacher conversation than those instances without an additional invitational move from the coach. When coaches used an additional invitational move when initiating conversation about an annotation containing a question, teacher exhibited higher levels of conversation about the annotation when compared to instances in which only one of the variables was present.

Two variables were also found to have negative associations with the extent of teacher conversation about an annotation. First, instances of annotation discussion in which the coach used an additional directive move (e.g., suggestion, explanation, or evaluation) were associated with lower levels of teacher conversation about the annotations. Second, teachers talked less about the annotations when the annotation reference was used to *advance the conversation to the next sequential annotation*.

Prior studies examining the discussion of teacher-created annotations, such as Stockero et al. (2017) and Walkoe (2015), have focused on analyzing written annotations and reflective conversation about the annotations to identify evidence of teacher learning resulting from a professional learning experience. These researchers made claims that changes in the annotations and conversational patterns across time were indicative of teacher

learning. The findings from this study extend these prior claims by highlighting associations between the content of an annotations and the extent of teacher conversation about the annotation. Specifically, annotations that contained questions correlated with higher levels of teacher conversation than annotations without questions. Conversely, annotations containing suggestions, explanations, or evaluation were associated with lower levels of teacher conversation. Given annotations were intended to catalyze reflective conversation, this finding highlights a potentially important relationship. Coaches aiming to elicit reflective dialogue from teachers might consider intentionally embedding additional questions within their annotations and strategically limiting their use of suggestions, explanations, and evaluations.

These findings also provide new knowledge about the role of coaches' discursive moves when discussing annotations with respect to the level of teacher conversation. This knowledge builds from Heineke's (2013) recommendation about the need to examine the discourse moves coaches use within one-on-one coaching conversations and the impact of these coaching moves on teacher discourse. Heineke (2013) suggested coaching moves that position the teacher as the primary authority when reflecting on practice supported higher levels of teacher discourse. The findings from the present study supports and extended this claim in several ways. First, when teachers initiated conversation about annotations they created, they contributed significantly higher levels of conversation when compared to instances of conversation about coach-created annotations or instances that were coach-initiated. However, this finding is limited by the low number of instances of teacher-initiated discussion about teacher-created annotations. Despite this limitation, the finding raises questions about why teachers infrequently initiated conversation about their own annotations

and necessitates future research to further validate this claim. Thus, coaches might consider using discursive moves that position teachers to discuss their own annotations but need additional research confirming such moves are associated with higher levels of teacher discourse.

Second, when coaches used invitational moves to initiate conversation about annotations, teachers contributed higher levels of conversation than instances without invitational moves. This suggests reflective coaching moves are associated with higher levels of teacher discourse within the context of discussing annotation. This claim is strengthened by contrasting it with the finding regarding the negative relationship between the presence of directive discourse moves and lower levels of teacher discourse. Within a context of one-on-one coaching, this finding is consistent with prior research about small group facilitation that suggested a facilitator asserting their expertise constrained teacher conversations (Amador & Carter, 2018). Parallel to the prior recommendation about including questions in written annotations to support higher levels of teacher discourse, coaches aiming to elicit reflective dialogue from teachers might consider using more invitational moves when discussing annotations. This recommendation may seem self-evident. However, as illustrated from the findings from research question two, coaches most commonly used explanation when initiating annotation discussion and only used additional invitational moves in approximately 25% of instances of coach-initiated annotation discussion.

Third, discussing the annotations in a sequential order was associated with significantly lower levels of teacher conversation. Recall that 97.3% of instances of annotation discussion coded as *advance the conversation to the next sequential annotation*

were also coded as none or low for the amount of teacher conversation about the annotation. A potential explanation for this finding is that discussing annotations in this way sends an implicit message to teachers about the need to discuss *all* annotations within a limited amount of time. Thus, teachers may have contributed little or no conversation within instances of annotation discussion due to the recognition that there were many annotations to discuss in a limited amount of time. This study cannot make claims regarding why sequentially discussing annotations caused the low levels of teacher conversation since no data was collected about teacher perceptions. However, this finding may encourage coaches and professional developers using video annotations to promote reflective conversation with teachers to be cautious about structuring the conversations in ways that result in the sequential discussion the annotations.

Implications

Practicing Coaches

Based on the findings from each of the three research questions, three primary implications for coaches using video annotations within coaching cycles are provided. First, coaches are encouraged to be intentional in the stance they use when creating annotations to highlight salient moments within lesson video and how they pair their discourse moves with the stance of the annotation. Data revealed that both the stance of the written annotation and the discourse moves coaches used when initiating conversation about the annotations correlated with the amount of teacher conversation about the annotations. Specifically, the presence of a question in an annotation and the coaches' use of invitational moves to initiate conversation about the annotations were independently associated with higher levels of teacher conversation. However, when both the annotation and the discourse move of the

coach contained questions, levels of teacher conversation were higher than those instances in which questions were only present in the written annotation or the discourse move.

A potentially obvious suggestion for coaches, based on this finding, is to create more annotations that include questions and then to use more invitational moves during the debrief conversation to elicit teacher thinking about the questions contained within the annotations. A less obvious implication, however, is that coaches often encounter situations in which a teacher may benefit from the coach sharing their expertise in the form of a suggestion or explanation (West & Cameron, 2013). In these situations, coaches can consider how to best leverage both written and spoken language to share their expertise while still catalyzing higher levels of teacher conversation. For example, a coach might create an annotation containing a suggestion about the use of an instructional move and a question about how that move may have supported students in that moment. Then, during the debrief conversation, the coach might use invitational moves to initiate conversation about the annotation, allowing the teacher to reflect on that moment in the lesson as well as the coaches' written suggestion and question. While the data sets from this study were not large enough to make claims about this specific pairing of written and spoken communication by the coach, (nor other combinations of annotation stances and discourse moves), the associations revealed by the data invite coaches to be intentional with their stance when creating written annotations to highlight moments within a lesson and also when selecting discourse moves to initiate conversation about the annotations.

The second implication involves coaches' use of annotation references to influence the conversation. One clear suggestion is to be cautious of sequential discussion of the annotations given the extremely low levels of teacher conversation associated with this use

of annotations. Coaches may also use these findings to reflect upon their own use of annotations when facilitating debrief conversations and how these different uses may support the diverse needs of the teachers they support. For example, when working with a teacher who tends to become overly focused on a single classroom event, potentially resulting in too much conversation about a single moment or student, the coach might consider using the annotations to introduce new and unrelated topics into the conversation. Introducing new topics might support such a teacher to reflect upon a greater number of important moments and interactions in the lesson. Conversely, in situations in which a teacher struggles to reflect beyond superficial elements of moments in a lesson, a coach might consider using an annotation reference to make a connection between the current topic under discussion and an annotation. For example, when discussing student misconceptions, a coach might reference an annotation containing a quote from a student who exhibited this misconception. Using annotations in this way may support a teacher to deeply analyze critical moments in a lesson and grow their reflective capacity.

The third implication involves the ways coaches position themselves and their teachers to initiate conversation about the annotations. Findings indicated that coaches talked more about the annotations than teachers and tended to talk more about the annotations they created as compared to annotations the teachers created. In the few instances in which teachers initiated conversation about their own annotations, data showed significantly higher levels of teacher conversation. Therefore, coaches might consider moves to position teachers to talk about the annotations they created. For example, coaches might provide teachers with private think time at the beginning of the debrief conversation to review annotations and invite them to select a specific number of coach-created annotations

and teacher-created annotations that they feel are important to discuss. Coaches could also provide similar framing instructions prior to the debriefing conversations as part of the asynchronous activities. Coaches might also consider using invitational moves that press teachers to select interesting teacher-created annotations to discuss in addition to using invitational moves to initiate conversation about annotations they believe are worthwhile. This suggestion is not meant to promote the idea that the coaches' primary role during a debrief conversations is to position teachers to talk about their own annotations. Rather, it is to encourage balance in the conversation regarding who initiates conversation about whose annotations given the findings that coaches tended to initiate conversation about their own annotations yet instances of teachers talking about their own annotations were correlated with higher levels of teacher conversation.

Professional Development Providers

Findings from this study revealed high levels of variability in the ways the nine coaches used annotations during debriefing discussions with teachers. This variability was found in the number of annotations discussed within a single conversation, the percentage of stanzas containing instances of annotation discussion, and the ways coaches used the annotation references to influence the conversation. These findings raise two critical implications for professional development providers using video-assisted coaching cycles. First, professional developments project leaders should examine the diverse ways coaches use annotations during debrief conversations and consider the productivity of these different coaching actions in relation to the project goals. Second, based on this analysis, project staff should take steps to support coaches and teachers to enact certain common practices deemed

to be productive. Each of these two implications and their relationship to the findings of this study will be discussed further within this section.

With respect to analyzing and evaluating coaches' actions involving the discussion of annotations, two perspectives should be considered. From one perspective, coaches are professionals who must be afforded autonomy to make decisions based on their unique strengths, experiences, and contexts as well as the learning needs of their teachers. From a competing perspective, high levels of variability in the actions of coaches may lead to disparate learning opportunities for teachers (Sailors & Price, 2015). In this study, the diverse actions of the coaches illuminated the tension between these two differing perspectives. In the case of coach Braithewhite and the teacher Summers, only three instances of annotation discussion were found in the debrief conversation and only 16% of their transcript stanzas contained instances of annotation discussion. In contrast, data showed coach Whilton and teacher Morrison engaged in 16 instances of annotation discussion and 62.5% of transcript stanzas contained instances of annotation discussion. These two cases, and others highlighted by the findings, suggest that coaches may have held different and even competing interpretations regarding the role of annotations in reflective discussions. Coach Braithewhite did not appear to prioritize the discussion of annotations to the same extent as coach Whilton. Although, definitive claims about the causes of the differences in the coaches' actions cannot be made, the data suggest teachers, such as Summers and Morrison, had different experiences in terms of engaging in reflective discussion about video annotations. These differences in the learning experiences of teachers could serve as a starting place for other projects using video annotations within video-assisted coaching cycles to navigate the tensions created by the competing forces of

autonomy and consistency in the actions of coaches when discussing annotations during debriefing conversations.

To help create more equitable learning experiences for participating teachers, professional development providers may consider two actions to establish basic levels of consistency in the ways coaches use annotations during debrief conversations. First, project leaders might provide coaches with clear statements about the purpose of annotations in relation to the desired learning outcomes of the project. These statements could be coupled with a small number of suggested actions for coaches regarding the use of annotations during the debrief conversations. These statements of purpose and suggested actions could be partially derived from the finding of this study. For example, project leaders may state the purpose of creating annotations is to provide the coach and teacher with a private opportunity to engage in reflective thinking about the lesson prior to conversation; akin to providing students with private thinking time about a mathematical task before beginning collaborative work. Each annotation is considered a written artifact that highlights parts of this reflective thinking and a select number of annotations should be used to catalyze reflective discussion about crucial moments in the lesson. Based on this conceptualized purpose, project leadership might also instruct coaches and teachers, prior to the debrief conversation, to select two annotations they created, and two annotations their partner created that they feel are important to discuss. Such guidance might provide a baseline level of consistency in the use of annotations within the conversations and support more equitable participation from coaches and teachers while still affording coaches autonomy to facilitate the conversations.

As a second action, project leaders might also create opportunities for coaches to collaboratively discuss their interpretations regarding the purpose of annotations and the actions they use to discuss annotations with teachers during debrief conversations. These conversations could make use of the research questions in this study. For example, coaches might discuss the number of annotations they believe are productive to include in a conversation, how they balance initiating conversation about annotations while providing opportunities for teachers to initiate conversation about annotations, the discursive moves they use when initiating conversation about annotations, and the ways they use the annotation references to guide the conversation. This form of professional discourse could create learning opportunities for coaches which may translate into more consistent actions with respect to how coaches use the annotations during debriefing conversations.

Future Research

This study holds several implications for researchers and future studies. First, numerous claims in this study were constrained by small sets associated with particular variables of interest. For example, the study began with a set of 308 annotations created by the nine coach/teacher pairs. Only 96 of these annotations were taken up in discussion and only six instances of annotation discussion were initiated by teachers about teacher-created annotations. Therefore, claims involving instances of teacher-initiated discussion about teacher-created annotations were constrained. Future studies should expand upon the preliminary findings reported in this study by starting with larger sets of annotations from a larger number of video-assisted coaching cycles.

Second, to further examine the interpretations of claims made within this study, future research should examine the perceptions of coaches and teachers regarding the role

and use of annotations within debriefing conversations. For example, recall the variability in the number of annotations discussed by coach Braithewhite and coach Whilton or the diverse ways coach Alvarez and coach Bishop used annotation references to guide the conversations. The underlying causes of these differences need to be investigated more thoroughly using the perceptions of the coaches. As has been previously mentioned, it is plausible coaches had different interpretations regarding the role of the annotations, the goals of the debriefing conversation, and/or and the best ways to leverage the annotations to create learning opportunities for teachers. It is also plausible these actions were driven by the context surrounding the conversation such as the amount of time available for the debrief conversation or the coaches' perceptions of the needs of their teacher. Similarly, future research should examine the perceptions of the teachers to analyze how the actions of the coaches impacted their learning opportunities.

Third, data showed positive relationships between individual variables within instances of annotation discussion and teachers' amount of conversation about the annotations. For example, instances of annotation discussion in which the coach used invitational moves to initiate conversation were positively related to the amount of teacher conversation about the annotation. One relationship was also found when accounting for the combination of the written stance of the annotations and the coaches' discourse moves when initiating conversation about the annotations. Specifically, when coaches combined invitational discourse moves to initiate conversation about annotations that contained questions, teachers tended to talk more about the annotation when compared to instances in which only one or none of these conditions were present. However, due to the relatively small data set, other combinations of the written annotations stance and the coaches'

discourse moves and their relationship with the amount of teacher conversation were not examined. Future research should examine the interaction of the discourse moves of a coach and the stance of annotations with respect to the amount of conversation contributed by the teachers. For example, if a coach created an annotation containing a suggestion, coaches would benefit from knowing which discourse moves tended to catalyze the most teacher conversation when initiating conversation about annotations with this particular stance. Findings from this study would lead to coaches to believe that invitational moves would be most effective towards this goal, however, there may exist subtle and more complex interactions between written and verbal communication and these interactions need further examination.

Finally, this study used the quantity of teacher conversation about the annotation as the primary variable to explore relationships with the various uses of annotations. However, the amount of teacher conversation does not necessarily guarantee improved learning outcomes for the teacher. For example, while teachers contributed higher levels of conversations during instances of teacher-initiated conversation about teacher-created annotations than instances of coach-initiated conversation about coach-created annotations, this study was not able to claim that one instance was superior to the other in terms of teacher learning. Future studies should build from these findings and conduct a more detailed examination of the teachers' discursive contributions in order to describe how the various uses of annotations during debrief discussions afforded and constrained teachers' learning opportunities.

Conclusion

Prior studies have shown that debriefing an implemented lesson with a coach (e.g., Kraft et al., 2018) and viewing and discussing lesson video (e.g., Gaudin & Chaliès, 2015; Gibbons & Cobb, 2017; Gröschner et al., 2018) can support teachers to engage in productive discourse about their practice. In the context of video-assisted coaching cycles, viewing video and debriefing a taught lesson are combined into a single professional development activity. In this activity, annotations are the primary tool for teachers and coaches to highlight salient moments of a lesson video and catalyze professional discourse (e.g., Amador, Carson, et al., 2019). This study intended to create new knowledge for coaches, professional development providers, and mathematics education researchers regarding how lesson video and annotations during video-assisted coaching cycles get taken up by a coach and teacher during debriefing conversations.

Guided by three research questions, the researcher examined the annotations and subsequent debrief conversations of nine coach/teacher pairs. The findings from this study may provide coaches and professional development providers with practical guidance for implementing video-assisted coaching cycles involving annotations. For example, findings from research question one described the average number of annotations discussed in a typical conversation and the percentage of debrief conversations containing instances of annotation discussion. These averages could support coaches and professional development providers to set realistic goals regarding how many annotations can be productively discussed in a single debrief conversation. Furthermore, findings from research question three suggest coaches should consider including more questions in their annotations and use

more invitational moves when initiating conversation about the annotations in order to increase the amount of conversation elicited from the teacher.

Trends in the data also opened several new questions about the use of annotations in debriefing conversations for both practitioners and researchers. As a first example, the high level of variability in the way coaches used annotations within the debrief conversations raises questions about the unique ways coaches may be interpreting the role and goal of annotations in catalyzing reflective discussion. This variability also raises questions about the diverse ways teachers may have experienced these reflective discussions and how it may have influenced their learning opportunities. As a second example, the high frequency of coaches initiating conversation about coach-created annotations and the low frequency of teachers initiating conversation about teacher-created annotations raises questions about best practices for coaches, who hold a potential position of power, when supporting teachers to reflect on their practice. For practicing coaches, these questions can serve as productive inquiry questions when facilitating video-assisted coaching cycles with annotations. For researchers, these questions highlight potentially productive next steps for future research.

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Appendix A

An annotation and portion of the debrief conversation transcript illustrating an example when the extent of teacher talk about the annotation was coded as high.

Annotation created by coach Whilton:

> I noticed that you selected/sequenced the area subtraction strategy to start the summary discussion? What was your rationale for this sequence? If you were to do it over again, would you start with this strategy? Why or why not? (By the way, I constantly ask myself the same question at the end of a lesson regarding my sequence order so this is genuine question, not a judgement! =)

Debrief conversation transcript in which teacher Morrison and coach Whilton discuss the annotation:

Stanza 35

Whilton: Other comments you saw in here that are worth chatting about?

Morrison: Yes. I wonder if I can find it. At 10:33 on day three of four, I noticed you selected *[echoing 47:20]* to start with, and *[echoing 47:27]*. I have no idea why *[laughter]*. I have no idea. Honest to goodness, do not know. In fact, in the other classes, I made it a particular note—I made it a point to myself not to do that, because I wanted to start with 10, and then adding 8, and go the 10 and 8 47:55. I have no idea why I did that.

Stanza 36

Whilton: I find myself, and now and then, it happens, too, where you get excited about a strategy and so it's, "Wait, why did I do that? I just was excited, and I had this kid come up." In hindsight, would you have done that? Would you have used that strategy?

Morrison: I think I like progression or starting—looking at each length, as it changes around the border, and then going to segments of the border, and then holding that variable until…One strategy that I didn't really know a word for it, but it's interesting. It would be nice to know what you thought, where kids were either adding the four 48:51 at the end, or—oh, shoot. I wish I had—do you remember Laura that went up 48:59? She was one that did way. Actually, I had a student in fourth hour who did the same thing. It was almost like *[echoing 49:13]*. It didn't fit all the other strategies—kind of like loaner. It wasn't taking off the corners to begin with. Putting the corners back in, was one of them. Would you do that towards the end? To me it seems like a little bit higher-level thinking. I'm not sure. How do you stack 49:33 the strategies?

Stanza 37

Whilton: That's a good question. Would you mind muting again? The feedback is coming through hard again. I would say, it goes back to your lesson goal, and I think there's two lesson goals. It's almost like you need to think about them both at the same time, perhaps. Your lesson goal about the generalizing, I think the one you're talking about—if it was a 10 by 10, it's like 8, plus 8, plus 8, plus 8, and then you add the corners—that's harder to generalize in my opinion, because it's ultimately going to be 4, times the quantity n minus 2, plus 4. To me, if I was doing a summary, I don't think I would want to start there. Even if that was easy for the kids to see initially, that would be harder to generalize, whereas some of the other strategies are easier to generalize. That's sort of speculative, because you know your kids better, and what they would find.

Were there strategies—again, with the luxury of time and reflection—were there strategies that you felt, if you'd do it differently that, "I would have started with that one, because that would have been an easier one to generalize," or you were pretty content with how you did it?

Morrison: In terms of generalizing, I think I would have wanted to take—there are two that I'd want to focus on: the 10 minus 8 51:12. No, I'm sorry. The 8, 8, 10, and 10. In terms of general expression, I almost feel like that one—I think because that's just n plus n, plus n minus two, n minus two.

Whilton: Yes. N plus n, plus n minus two, plus—

Morrison: I mean, when we went through it, they were able to get those numbers very quickly. I wrote n plus n, and kids were really quick to say, "Oh, that seems to be n minus two." Actually, I'll keep that one. I think in the future, next time, I would focus on those two, and have kids spend more time just on those two, and have them create general expressions. Then, if we had time after that 52:17, where we use the other one, maybe.

Chapter 5

Conclusion

Coaching has become a common form of professional development in the United States to improve learning opportunities for teachers (Campbell & Griffin, 2017; Desimone & Pak, 2017). There exists evidence coaching can improve teaching and learning in mathematics education; however, results on the effectiveness of coaching have been inconsistent (Blazar & Kraft, 2015; Campbell & Griffin, 2017; Ellington et al., 2017). Campbell and Griffin (2017) argued erratic outcomes were the result of significant variance in coaching activities and the actions of coaches. Such findings about variability in coaches' actions and coaching outcomes are significant to both research studies in this dissertation as they highlighted coaching has the potential to improve teaching and learning in mathematics classrooms while also establishing a need for further knowledge about *how* mathematics coaches interact with teachers within various coaching activities (Gibbons & Cobb, 2016).

To address this lack of knowledge regarding how mathematics coaches interact with teachers, this dissertation contained two research projects focused on examining the discursive actions of mathematics coaches when working with teachers during video-assisted coaching cycles. In the first study, the researcher examined the existence of reflective and directive stances of mathematics coaches during their coaching cycle conversations with teachers. The purpose of this study was to examine coaches' discursive tendencies and to explore the variability in how coaches talked with teachers during coaching cycles. The second study addressed the lack of knowledge about coaches' actions

by examining how coaches leveraged written annotations to support professional discourse around important classroom events during debriefing conversations. The annotations were created by teachers and coaches while watching lesson video during video-assisted coaching cycles.

Both studies focused on how coaches interacted with teachers but did not contain claims about why variability existed in the coaches' actions or how the variability impacted the learning opportunities of teachers. With respect to the lack of claims about why the coaches' actions differed, data analyzed for both projects did not capture the many contextual variables that potentially impacted coaches' decisions when interacting with teachers. For example, contextual variables such as the teachers' schools, districts, available curricular resources, and prior experiences with professional development as well as the existing relationships between the coaches and teachers may have influenced the learning needs of the teachers and the actions of the coaches. Data analyzed for both studies did not consider these variables which limited the researcher's ability to make claims about the causes of coaches' diverse actions. With respect to the lack of claims about how variability in the coaches' actions impacted teachers' learning opportunities, data involving teachers' prior learning in the online course and online teacher labs were not analyzed. Furthermore, teachers' actions in response to the coaches' actions were not thoroughly analyzed which limited the researcher's ability to make claims about the impact of coaches' actions on the teachers' learning opportunities.

Despite these limitations, two primary themes emerged from the findings of the two studies regarding how mathematics coaches interacted with teachers during coaching cycles. Each of these themes will be discussed independently in the sections below.

Theme One: Variability in Coaches' Actions

In both studies, there existed significant variability in how coaches interacted with teachers. In Chapter Three, the three focal coaches varied in their overall use of reflective and directive moves as well as their use of specific discourse moves. Coach Alvarez used a greater percentage of reflective moves and primarily used invitations, coach Bishop used a greater percentage of directive moves and favored the use of suggestions and explanations, and coach Reiss used an approximately equal percentage of reflective and directive moves. Additionally, there existed variability in the intensity of a coaches' stance within conversational segments of coaching conversations. Reiss tended to hold more intense coaching stances (i.e., highly directive or highly reflective), Alvarez strongly favored the use of a moderately reflective stance, and Bishop favored the use of both moderately and highly directive stances.

In Chapter Four, findings indicated the nine coach/teacher pairs varied significantly with respect to the number of annotations discussed during the debriefing conversations compared to the number of annotations created prior to the conversations. For example, coach Braithewhite and teacher Summers collectively created 50 annotations and discussed three of these annotations during the debrief conversations. In contrast, coach Bishop and teacher Parsons created 23 annotations and discussed 21. The coach/teacher pairs also varied in the percentage of conversations that focused on the annotations. For coach Hale and teacher Swanson, 20% of conversational stanzas contained instances of annotation discussion whereas 62.5% of conversational stanzas contained instances of annotation discussion for coach Whilton and teacher Morrison. Finally, coaches varied in how their references to the video annotations influenced the conversations. For example, data

suggested three coaches tended to use annotations references to shift the conversations to new topics not explicitly related to the topic currently being discussed, two coaches tended to use annotation references to introduce ideas explicitly related to the current topics being discussed and one coach discussed the annotations in sequential order.

This variability in how coaches talked to teachers and how coaches talked about the video annotations is significant to mathematics education because it highlights teachers had differing experiences within the coaching cycle conversations. For example, in Chapter Three teacher Wise experienced a small percentage of reflective conversational segments whereas most of the conversational segments for teachers Graham and Marks were reflective. In Chapter Four, teachers Summers and Swanson engaged in minimal conversation about annotations during their debrief whereas teachers Parsons and Morrison experienced a debriefing conversation that focused heavily on the annotations.

Building from this theme of variability from both studies, future research should focus on two areas. First, future studies should examine the potential causes of the variability in the actions of coaches. This includes investigating the extent to which coaches' diverse actions are the result of coaches being responsive to the learning needs of teachers versus the extent to which these diverse actions are the result of inherent characteristics of the coaches. This also includes investigating the extent to which coaches are aware of their actions and coaches' perceptions about how their actions align with overarching learning goals for teachers set by the professional learning program. Second, future studies could build from the findings of these two studies to explore the impact of coaches' diverse actions on teachers' learning opportunities. New knowledge about these topics could help practicing coaches and professional development providers negotiate the tension between affording

coaches opportunities to act as autonomous professionals while also providing teachers with consistent and equitable learning experiences.

Theme Two: Implications of Power Based on Coaches' Actions

Mosley Wetzel and colleagues (2017) argued a coach, or any kind of formal mentor, holds a position of power and is often perceived by the teacher as being more accomplished and knowledgeable. Thus, the actions of a coach can position a teacher as the primary authority within a conversation or relationship. From this position of authority, the teacher can co-construct new knowledge with a collegial coach. Mosley Wetzel and colleagues (2017) claimed the actions of a coach can also position the coach as the primary authority, relegating the teacher to the position of a more novice mentee. From this position, the teacher depends on a coach for new knowledge. Therefore, coaches can have significant influence on the roles teachers assume during coaching conversations.

In both studies, the actions of the coaches within the video-assisted coaching cycles carried potential implications of operating from a position of power related to Mosley Wetzel and colleagues (2017) claims. In Chapter Three, findings showed that despite the variability in coaches' discursive tendencies, all three coaches regularly used directive discourse moves and held directive stances during coaching conversations. Even Alvarez, who was characterized as the most reflective and least directive of the three coaches, had more than one-third of her coaching moves coded as directive. In Chapter Four, findings showed that coaches were significantly more likely than teachers to initiate conversation about the annotations and tended to initiate conversation about their own annotations instead of the teachers' annotations.

Designers of coaching models within mathematics education have different perspectives on coaches using actions that position themselves as the primary authority. In the cognitive coaching model, Costa and Garmston (2016) strongly cautioned coaches to avoid any moves that position themself as the primary authority. They argued such moves may support short term goals such as a teachers' ability to create a quality lesson with the support of a coach but limit teachers' opportunities to become autonomous and self-directed without the support of a coach. West and Cameron (2013) explicitly argued against this perspective from cognitive coaching and encouraged content-focused coaches to provide suggestions and direct assistance if needed. However, West and Cameron (2013) provided little additional guidance regarding how and when to use directive coaching moves. Thus, existing literature does not support coaches in making well-informed decisions about the use of directive coaching moves.

The prevalence of coaching actions that positioned the coach as the primary authority within both studies and the disagreement about the affordances of such moves within existing coaching model literature warrants new knowledge about the topic. Future studies should empirically investigate the claims made by different coaching models about coaching moves that position the coaches as the primary authority and how those moves impact teachers. This should include examining how directive coaching moves (a) impact the implementation of the lesson within a coaching cycle, (b) are discussed by the coach and teacher in future coaching cycle conversations, and (c) impact a teachers' future practice without the presence of a coach. Future research should also examine how coaching actions that position the coach as the primary authority impact teachers' perceptions of their relationships with their coaches and the development of teachers' identities. New knowledge

about these topics could support practicing coaches and professional development providers to better understand how coaching actions impact teachers and could support coaches to make more intentional decisions about their actions.

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