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USEFUL, EASY, AND CONSEQUENTIAL: A PRACTICAL MEASUREMENT REPOSITORY TO ENHANCE THE WORK OF MATH EDUCATION INSTRUCTIONAL LEADERS AND TEACHERS

TEACHERS' DEVELOPMENT OF PROFESSIONAL VISION AND LEADERSHIP CONCEPTIONS IN AN ELEMENTARY MATHEMATICS SPECIALIST PROGRAM

LEARNING TO FACILITATE CONTENT-FOCUSED COACHING CYCLES: A COMPREHENSIVE FRAMEWORK TO SUPPORT COACHES' PROFESSIONAL GROWTH

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LEARNING TO FACILITATE CONTENT-FOCUSED COACHING CYCLES:

A COMPREHENSIVE FRAMEWORK TO SUPPORT COACHES' PROFESSIONAL GROWTH

Ryan Gillespie
University of Idaho
Jennifer Kruger
University of Rochester
Cynthia Callard
University of Rochester
Kenley Ritter
University of Idaho

ABSTRACT

This paper serves two purposes. First, we present the content-focused coaching implementation framework, a comprehensive tool to support mathematics coaches in navigating the complexities of facilitating coaching cycles with teachers. Second, we describe a research study in which we partnered with nine mathematics coaches and examined how the framework influenced coaches' perceptions of their professional growth when facilitating coaching cycles with local teachers. Through analysis of postcoaching cycle interviews, study participants reported the framework supported them to prepare intentionally for the three distinct phases of the coaching cycle (i.e., planning conversation, lesson implementation, debriefing conversation) and make responsive, "in-the-moment" decisions. Coaches also shared ways in which the framework sparked new insights about coaching. We discuss how our findings connected to and extended prior research on coach learning and the use of coaching tools. We also present implications of our framework and findings for practicing mathematics coaches and future researchers.

Coaching teachers has been shown to be an effective method for improving teachers' pedagogical practices and content knowledge (Desimone & Pak, 2017; McGatha et al., 2015; West & Cameron, 2013). In this paper, we considered a mathematics coach to be a mathematics specialist who has full- or part-time release from teaching responsibilities to collaborate with teachers (Baker et al., 2022; Mudzimiri et al., 2014; NCSM, 2019; Sutton et al., 2011). Mathematics coaches work to address teachers' individual needs through ongoing professional learning focused on content development, pedagogy, assessment, and curriculum (Campbell & Griffin, 2017; Neufeld & Roper, 2003; Obara & Sloan, 2009; Thomas et al., 2015).

In the wide array of professional learning activities available to coaches and teachers (Gibbons & Cobb, 2017), content-focused coaching (CFC) cycles have become a prominent activity in mathematics education (Bengo, 2016). A CFC cycle is a 3-phase activity in which a coach and teacher collaboratively plan, implement, and reflect upon a lesson. Aligned with principles of a CFC model (Callard et al., 2022; West & Cameron, 2013), the coach and teacher maintain focus on mathematical content and how students learn this content throughout a CFC cycle to provide individualized and job-embedded support that can deepen a teacher's knowledge of content and pedagogy. This continual focus on mathematics content distinguishes CFC from other forms of coaching, such as (a) instructional coaching, which focuses on general instructional and assessment strategies (Knight, 2007) and (b) cognitive coaching, which focuses on mediating teachers' thinking (Costa & Garmston, 2016).

The emergence of CFC cycles has been connected to educational policy shifts in the United States (Common Core Standards Initiative, 2010; Every Student Succeeds Act, 2015) which significantly raised expectations for improved student outcomes in mathematics. These shifts increased demands on teachers, requiring them to adapt their instructional strategies rapidly to align with ambitious and equitable mathematics teaching (Horn & Garner, 2022; Lampert & Graziani, 2009) to meet new or revised mathematics standards. To support teachers in shifting their instructional practices and increasing student achievement, school district personnel have turned increasingly to mathematics coaches and CFC cycles as a professional learning option (Desimone & Pak, 2017; McGatha et al., 2015; West & Cameron, 2013). Facilitating coaching cycles is complex, and the effectiveness of a CFC cycle relies on the coach's ability to act intentionally yet responsively (Stein et al., 2022). In planning conversations, coaches must learn to guide interactions in ways that maintain focus on essential ideas related to teacher development (West & Cameron, 2013) while also being

responsive to each teacher's individual needs in producing a high-quality lesson (Carlson et al., 2017). When collaboratively teaching, coaches must select forms of coteaching strategically based on a teacher's current practice and student needs (Saclarides, 2023). While reflecting on the implementation of lessons, coaches must have honest conversations about teachers' content knowledge and pedagogical practices that are grounded in evidence of student thinking (Varghese et al., 2023; West & Cameron, 2013). In sum, facilitating CFC cycles requires coaches to intentionally plan for and responsively enact three distinct yet interrelated interactions with a teacher, which formed the basis of our research.

The purpose of this paper was twofold. First, we presented the CFC implementation framework, a comprehensive tool to support mathematics coaches in navigating the complexities of facilitating one-on-one coaching cycles with teachers (see Appendix), and we described the processes used to create the framework. Second, we described a research study in which we analyzed nine mathematics coaches' perceptions of their professional growth when using this framework during coaching cycles with teachers in their local contexts. Our study answered the research question, "How did the CFC implementation framework influence coaches' perceptions of their professional growth when facilitating coaching cycles?" Exploring mathematics coaches' perceptions provided insights into how the framework influenced coaches' work with teachers, supported the growth of coaches, and generated authentic feedback to further refine the framework.

As a final opening note, our framework is directed at the use of CFC cycles because our work was grounded in this particular coaching model (Callard et al., 2022; West & Cameron, 2013; West & Staub, 2003). However, we believe the framework and results of this study apply to any coach, specialist, or teacher educator using coaching cycles to help mathematics teachers deepen their content and pedagogical content knowledge.

FRAMING LITERATURE

We framed our study using three bodies of existing literature. First, we discuss ambitious and equitable mathematics teaching because our coaching framework is designed to support coaches in working with teachers to engage in practices in line with this pedagogical model. Second, we present literature on CFC, the coaching model underpinning our framework. Finally, we review existing literature on coach learning and how coaching tools and structures support coaches' professional learning.

Ambitious and Equitable Mathematics Teaching

For over 3 decades, educational organizations and researchers have advocated for ambitious and equitable mathematics teaching, an instructional approach that strives to provide all students with access to rigorous mathematical learning opportunities (Horn & Garner, 2022; National Council of Teachers of Mathematics [NCTM], 1991, 2014; National Research Council, 2001). According to Smith et al. (2017):

> *In ambitious teaching, the teacher engages students in challenging tasks and then observes and listens while they work so that he or she can offer an appropriate level of support to diverse learners. The goal is to ensure that each and every student succeeds in doing high-quality academic work rather than merely executing procedures with speed and accuracy. (p. 4)*

Building from this broad vision, mathematics education organizations (NCSM, 2019; NCTM, 2014) and various researchers have highlighted the following high-leverage practices as critical components of ambitious and equitable mathematics teaching:

- establishing mathematics learning goals focused on understanding big ideas in mathematics (Hiebert & Grouws, 2007),
- implementing high-cognitive demand tasks that promote inquiry and provide access to all students (Smith & Stein, 2018),
- eliciting and responding to students' thinking (Leahy et al., 2005; Smith & Stein, 2018),
- facilitating meaningful and productive mathematical discourse that builds from students' reasoning and connects mathematical strategies and representations (Chapin et al., 2009; Smith & Stein, 2018; Staples, 2007), and
- supporting and promoting productive struggle for all students (Kapur, 2010; Warshauer, 2015).

Ambitious and equitable mathematics teaching often is found to be in sharp contrast to prevailing instructional methods and may be significantly different from teachers' own mathematics learning experiences (Horn & Garner, 2022). Thus, implementing such practices can present formidable challenges because implementation often requires mathematics teachers to make significant changes in, or even to completely overhaul, multiple facets of their professional practice (Star, 2016; Valoyes-Chávez, 2019). These changes often include adopting new beliefs about students' capacities for thinking and reasoning (NCTM, 2014), learning to use high-leverage instructional practices in responsive ways (Witherspoon et al., 2021), and acquiring new knowledge about mathematical content and how students learn this content (West & Cameron, 2013). Hence, mathematics teachers deserve and require high-quality professional learning experiences, including coaching (Smith et al., 2025), to support their implementation and refinement of ambitious and equitable mathematics teaching as they strive to help all students reach high levels of mathematical proficiency.

CFC

Schools and school districts across the United States have invested in mathematics coaches to provide professional learning opportunities that support mathematics teachers' development of ambitious and equitable mathematics teaching (Desimone & Pak, 2017; McGatha et al., 2015; West & Cameron, 2013). The term coach covers a range of definitions and descriptions and is often linked to a specific coaching model (Bengo, 2016). CFC, one such coaching model, emphasizes the subject matter taught and the use of

students' thinking to design and reflect upon instruction (West & Cameron, 2013; West & Staub, 2003). In line with principles of ambitious and equitable mathematics teaching, a content-focused coach's primary goals are to (a) increase a teacher's content knowledge and (b) increase a teacher's pedagogical content knowledge, which pertains to effective instructional practices related to the subject matter (Ball et al., 2008; Shulman, 1987).

The core activity of CFC is a coaching cycle, which consists of three distinct yet interconnected phases: the planning conversation, the lesson implementation (often referred to as coteaching), and the debriefing conversation (Callard et al., 2022; West & Cameron, 2013; West & Staub, 2003). During the planning conversation, the teacher and coach coconstruct a lesson that includes clear learning goals and cognitively demanding tasks (Callard et al., 2022). The lesson implementation phase involves the teacher and coach coteaching the coconstructed lesson with the coach assuming an active role in implementation based on the teacher's learning needs (Gillespie & Kruger, 2022). The debriefing conversation elicits reflections on the lesson's effectiveness by examining evidence of student thinking, considering contributing factors that may have impacted the lesson's effectiveness, and establishing implications for future practice (Gillespie et al., 2023). This approach to coaching promotes an authentic partnership as both the teacher and coach share responsibility for the success of the lesson across all three phases (Bickel et al., 2017; West & Cameron, 2013; West & Staub, 2003).

CFC cycles hold the potential to support teachers in implementing ambitious and equitable mathematics teaching effectively (Bickel et al., 2017; Witherspoon et al., 2021). However, existing literature on mathematics coaching continuously has highlighted the complexity of coaching, emphasizing that it takes time, often years, to develop the expertise necessary to facilitate one-on-one professional learning activities with teachers successfully (Carlson et al., 2017; Saclarides & Kane, 2021; Stoetzel & Shedrow, 2020). In the context of CFC cycles, this expertise begins with coaches possessing deep knowledge of mathematical content and instructional practices (Coburn & Russell, 2008; Gibbons & Cobb, 2016; Yopp et al., 2019). However, being knowledgeable of mathematical content and instructional practices associated with ambitious and equitable mathematics teaching is not enough. Coaches also must know how to facilitate coaching cycles with clear goals and intentionality while also being responsive to teachers' individual needs (Costa & Garmston, 2016; West & Cameron, 2013). The ability to act intentionally and responsively relies on a coach's understanding of how a coaching cycle can support a teacher's professional growth and how individual phases support the larger purpose. Building from this understanding, coaches must plan for interactions in each phase in ways that maintain focus on important pedagogical and mathematical ideas while being flexible to incorporate unique needs of individual teachers (Baker & Knapp, 2019; Russell et al., 2020). In addition, coaches need specific techniques to elicit and deepen a teacher's thinking about both content and pedagogy (Russell et al., 2020). During such interactions, coaches must be mindful of power dynamics because coaches often are positioned and perceived as more knowledgeable experts (Chval et al., 2010; MacPhee & Jewett, 2017; West & Cameron, 2013). Being mindful of power dynamics includes balancing the use of (a) directive coaching moves (e.g., suggestions and explanations) where the coach positions themself momentarily as a knowledgeable expert and (b) invitational questions where the coach positions the teacher to be the intellectual authority (Gillespie et al., 2025; Witherspoon et al., 2021). In short, the promise of CFC cycles is contingent upon a coach's knowledge and ability to navigate the inherent complexity of three separate but interconnected one-on-one interactions.

Tools That Support the Enactment of Specific Coaching Practices

In response to the complexity of coaching, numerous authors have created tools for coaches that recommend specific practices for use in coaching cycles. In some cases, a coaching tool has applications in a particular part of a coaching cycle. For example, Wills and Rawding (2019) created a protocol that describes a set of six practices a coach can use in a preliminary conversation with a teacher to set the foundation for upcoming coaching cycles. Kochmanski and Cobb (2023) designed a decision-making tool coaches can use to identify productive instructional goals for teachers when preparing for debriefing conversations. Smith et al. (2025) developed a four-move routine (i.e., invite, rehearse, suggest, and generalize) for coaches to use during planning conversations. Other authors have generated larger texts that provide coaches with comprehensive guidance for facilitating coaching cycles aligned with particular coaching models. For example, Costa and Garmston (2016), in their work involving cognitive coaching, presented "maps" highlighting broad structures and questions coaches can use when facilitating planning and debriefing conversations. Similarly, Knight (2007) and Sweeney (2011) have provided coaches with detailed instructions and recommendations for all three phases of coaching cycles that align with instructional and student-centered coaching models, respectively.

Complementing practitioner-facing literature, empirical evidence has suggested tools that articulate specific coaching practices (e.g., protocols, routines, models, frameworks) can support coaches' professional learning. We highlighted three examples of such tools in this paper. First, Baker and Knapp (2019, 2023) examined how their decision-making protocol for mathematics coaching (DMPMC) supports content-focused mathematics coaches to facilitate productive and targeted coaching interactions including, but not limited to, coaching conversations. Baker and Knapp found their protocol guided coaches to plan for coaching interactions and anticipate teacher responses, which supported coaches to act responsively during coaching conversations with teachers. Furthermore, findings suggested the DMPMC promoted self-reflection, enabling coaches to critically examine and refine their practices. Second, Russell et al. (2020) examined how coaches enacted specific coaching practices outlined in an inquiry-based mathematics coaching model. Russell et al. found coaches implemented and adapted presented practices during coaching cycles with teachers, leading to

conversations with greater depth and specificity. Third, Gillespie et al. (2023) examined how a conversational structure for debriefing a lesson with a teacher supported content-focused coaches in facilitating effective reflective conversations. Gillespie et al. found their debriefing conversational structure enabled coaches to balance the amount of teacher and coach dialogue and increased coaches' use of discourse that contained fundamental aspects of reflective thinking.

These examples illustrated that tools appear to be a promising way to support coaches to navigate the complexity of coaching and adopt new practices when striving to support professional growth of mathematics teachers. However, mathematics coaches lack a comprehensive and cohesive framework that outlines specific practices for all three phases of a coaching cycle aligned with CFC. Moreover, little is known about how such a framework might support coaches to adopt new practices when engaging in one-on-one interactions with teachers aiming to implement practices associated with ambitious and equitable mathematics teaching.

OUR CFC FRAMEWORK

In a recent project funded by the National Science Foundation (Grant #2006353), our author team, as part of a larger team of researchers and professional learning providers, designed, implemented, and researched a professional learning model to support mathematics coaches to facilitate CFC cycles. Through our work, we discovered existing CFC literature provided fragmented tips and guidance for facilitating coaching cycles. A detailed, actionable, and comprehensive guide did not exist to help coaches facilitate each phase of a CFC cycle with intentionality and coherence. This absence stood in noticeable contrast to the presence of actionable guidance from other coaching models. For example, Costa and Garmston (2016) provided conversational maps to guide coaches in facilitating both planning and debriefing conversations in ways that aligned with the guiding principles of the cognitive coaching model. Similarly, Knight (2017) detailed specific processes and coaching behaviors to implement all phases of a coaching cycle that aligned with the guiding principles of the instructional coaching model.

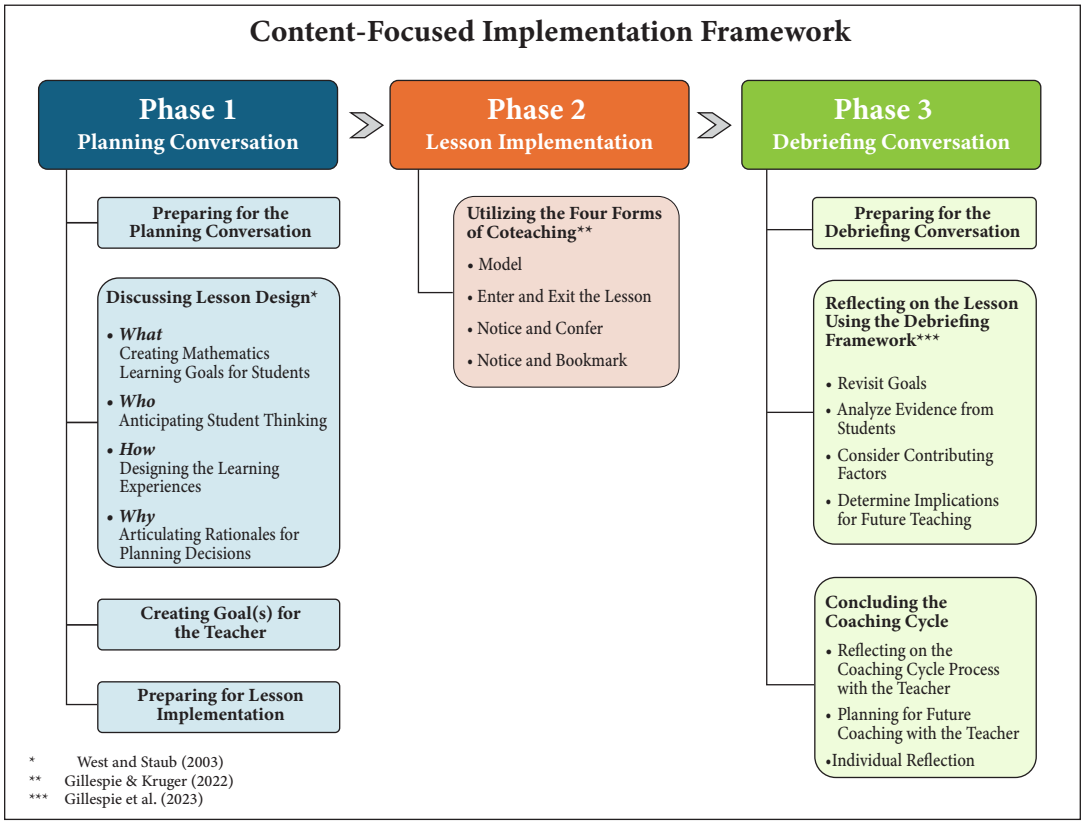
To address this gap and support coaches in our project in learning to facilitate CFC cycles, we created the CFC implementation framework (see Appendix). Figure 1 provides an overview of the content of this framework, which we describe in greater detail in the following section.

Creation Process

To create the CFC implementation framework, we engaged in biweekly conversations for approximately 2 years. We used a backward design process that leveraged our extensive experience as content-focused coaches and professional learning providers who support content-focused coaches. First, we articulated the outcomes and guiding principle of a CFC cycle (found on the first page of the framework in the Appendix). Next, we crafted ideal outcomes of each phase of the cycle that connected to overarching outcomes and the guiding principle (found in the top row of each part of the framework in the Appendix). With these outcomes as a foundation, we systematically deconstructed each phase of a CFC cycle into discrete elements and identified specific coaching practices associated with each element. Throughout the 2-year development of the framework, project researchers outside our author team provided ongoing feedback. Upon completing the first draft of the framework, we received extensive feedback from (a) project advisory board members, who were researchers with expertise on using coaching to support ambitious and equitable mathematics teaching and (b) the coaches who participated in this study. We compiled this feedback, which resulted in the CFC implementation framework.

Figure 1

The Elements of Each Phase of the CFC Implementation Framework



As illustrated in Figure 1, our framework has three parts: Phase 1: Planning Conversation, Phase 2: Lesson Implementation, and Phase 3: Debriefing Conversation. Each part is designed to guide practicing coaches to grow in their ability to facilitate a particular phase of a CFC cycle while also helping coaches recognize and appreciate coherence across the three phases. Each part of the framework contains multiple elements, and each element is decomposed into CFC practices distributed across three descriptive columns. The first column, "First Steps," outlines basic yet essential actions coaches can implement immediately in a CFC cycle with a teacher. The second column, "Next Steps," articulates coaching actions that build on the first steps to support coaches in fostering deeper thinking from a teacher. The final column, "Peak Performance," describes coach's actions that reflect the desired outcomes and guiding principle of a CFC cycle. The framework provides intentional support for coaches to manage potential power dynamics through their discursive choices (Witherspoon et al., 2021). For example, actions in the first steps tend to be invitational in nature to encourage coaches to position teachers as the knowledge authority at the start of discussion about a particular topic (Smith et al., 2025). Furthermore, outcomes in the peak performance column reinforce the big idea that the goal of coaching is to help teachers develop new habits and knowledge that will support effective teaching without the presence of a coach. Coaches may shift to use directive coaching moves when enacting descriptors in the next steps phase, but the descriptors of first steps and peak performance illustrate the importance of coaches incorporating ample opportunities to position teachers as the intellectual authority.

Foundational Models for Each Part of the Framework

Each part of the framework is a synthesis of our experiences and our research team's thorough review of coaching support structures available in the existing literature. Elements of Phase 1: Planning Conversation are grounded in the work of West and Staub (2003) who articulated a 4-part structure for a CFC planning conversation. In this structure, the coach engages collaboratively with a teacher to consider the (a) what (i.e., mathematical content goals), (b) who (i.e., anticipated student thinking), (c) how (i.e., lesson design), and (d) why (i.e., decision rationales) when preparing a lesson. During typical lesson planning, teachers often focus their attention on how curricular materials will be implemented without addressing what, why, and who associated with the lesson (West & Cameron, 2013). West and Cameron (2013) argued coaching questions beyond the how of lesson design "essentially change teacher thinking and trigger more reflective lesson planning habits of mind" (p. 98).

Phase 1: Planning Conversation includes these four elements and further articulates actions a coach can use when coconstructing a lesson with a teacher. As an example, Figure 2 illustrates how we incorporated the "what" component of West and Staub's (2003) work as a single element in Phase 1 of the framework. Phase 1 contains three additional elements beyond the Guide to Core Issues that focus on (a) preparing for the planning conversation (Smith et al., 2025), (b) creating instructional practice goals with teachers (Kochmanski & Cobb, 2023), and (c) preparing for different forms of coteaching (Saclarides, 2023) during the lesson.

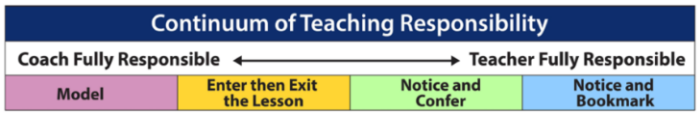
Elements of Phase 2: Lesson Implementation incorporate our previous work in which we developed a coteaching structure, the continuum of teaching responsibility (Gillespie & Kruger, 2022), to describe various coaching roles for collaborative lesson implementation (see Figure 3). A core feature of CFC is that the teacher and coach coteach the lesson, sharing accountability for both the lesson design and implementation, which, in turn, supports authentic collaboration (Gillespie & Kruger, 2022). Hence, when coteaching, the teacher and coach actively collaborate during lesson implementation, as opposed to other models of coaching where the teacher and coach might work with separate groups of students or where the coach solely observes the teacher's instruction (Saclarides, 2023; West & Cameron, 2013). The continuum of teaching responsibility presents four options for a coach's coteaching roles differentiated by the amount of responsibility the coach assumes for teaching.

Figure 2

Example of the Integration of West and Staub (2003) Into the Framework

Elements	First Steps	Next Steps	Peak Performance
***What*: Creating Mathematics Learning Goal(s) for Students**	Teacher or coach states the mathematics learning goal(s) for students.	Teacher and coach discuss: • ways to make the goal(s) more focused on learning and understanding. • how the lesson/task aligns with the mathematical goal(s). • evidence of student thinking that would indicate the goal(s) was met. • how the goal(s) relates to important mathematical ideas. • how the goal(s) connects to students' prior learning. • how the goal(s) of this lesson are part of a coherent set of learning experiences.	Teacher and coach discuss how *creating mathematics learning goal(s) for students* supports ambitious mathematics teaching and improves student learning. Teacher and coach discuss the teacher's next steps in making *creating mathematics learning goal(s) for students* a planning habit.

Figure 3
Continuum of Teaching Responsibility

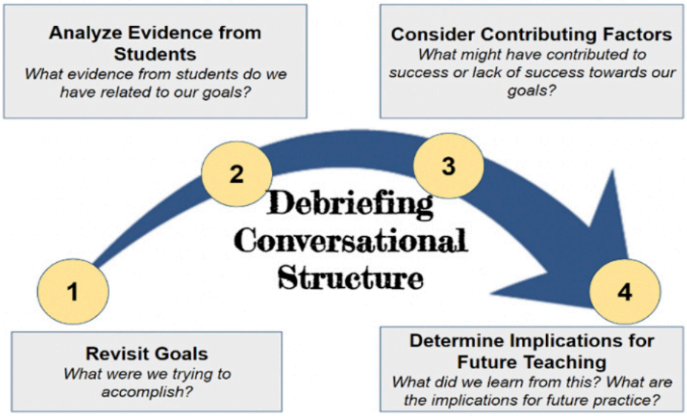


Note. From "With the Right Strategies, Coaches Can Leverage Co-Teaching," by R. Gillespie and J. S. Kruger, 2022, *The Learning Professional,* 43(2), p. 45 (https://learningforward.org/journal/coaching-for-change/with-the-right-strategies-coaches-can-leverage-co-teaching/). Used with permission of Learning Forward, www.learningforward.org. All rights reserved.

These forms of coteaching can shift throughout a lesson and support a coach to work toward the goals of the teacher and students. Figure 4 illustrates how the model component from the continuum of teaching responsibility is integrated into Phase 2 of the framework.

Elements of Phase 3: Debriefing Conversation also expanded on our earlier work in which we created a structure to guide content-focused coaches in facilitating debriefing conversations in the final phase of a CFC cycle (Gillespie et al., 2023). The debriefing conversational structure phase (see Figure 5) merges structures from other coaching models (Costa & Garmston, 2016; Knight, 2007) with the primary goal of CFC, which is increasing the teacher's content and pedagogical content knowledge (West & Cameron, 2013). The debriefing conversational structure comprises four phases to guide coaches in facilitating debriefing conversations: (a) revisit goals, (b) analyze evidence from students, (c) consider contributing factors, and (d) determine implications for future teaching. Phase 3 uses these four elements to articulate actions a coach can use to engage in a productive debriefing conversation.

Figure 5
Debriefing Conversational Structure



Note. From "Learning to Facilitate Reflective Conversations: Exploring Changes in the Practices of Mathematics Coaches" by R. Gillespie, J. Kruger, A. Hanan, and J. Amador, in T. Lamberg and D. Moss (Eds.), *Proceedings of the forty-fifth annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 686–695). International Group for the Psychology of Mathematics. Copyright by the International Group for the Psychology of Mathematics, 2023.

Figure 6 depicts how we integrated the component of "analyze evidence from students" from the debriefing conversational structure into our framework. Phase 3 contains four elements beyond debriefing conversational structure that focus on (a) preparing for the debriefing conversation, (b) reflecting on the coaching cycle process with the teacher, (c) planning for future coaching, and (d) engaging in individual reflection. The Peak Performance section of Phase 3 emphasizes the interconnectedness of each element of the debriefing conversational structure and the integration of teacher learning into future practice. The concept of peak performance remains consistent for all components of the debriefing conversational structure phase.

Figure 4
Example of the Integration of the Continuum of Teaching Responsibility Into the Framework

Elements	First Steps	Next Steps	Peak Performance
Model	Coach models a portion of the lesson while the teacher observes.	Coach finds moments while modeling to make their decision- making process explicit with the teacher Coach and teacher find opportunities to discuss what they are noticing about student thinking. Coach provides the teacher with opportunities to retake responsibility of the teaching.	Coach models the lesson in ways that draw attention to aspects of practices related to the teacher's learning needs and instructional practice goals. Coach and teacher find opportunities to listen to each other's noticings about student thinking and the coach makes instructional decisions based on these shared noticings.

Figure 6
Example of the Integration of the Debriefing Conversational Structure Into the Framework

Elements	First Steps	Next Steps	Peak Performance
Analyze Evidence from Students	Coach and teacher discuss specific instances of student thinking using artifacts such as student work or observation notes.	Coach and teacher: • discuss how the evidence of student thinking connects to the mathematical learning goals. • use evidence of student thinking to collaboratively make and support claims about student understanding.	Coach and teacher make connections between the mathematical learning goals, evidence of student thinking, and contributing factors to identify important and specific implications for the teacher's future practice. Coach and teacher co-construct specific next steps that support the teacher to embed new learning in their regularly occurring practice.

METHODS

Project Context

This study was an extension of a 2-year professional learning project for mathematics coaches learning to facilitate CFC cycles with teachers (see Amador et al., 2021). The larger, 2-year project supported 30 mathematics coaches working in rural areas across the United States to improve their abilities to (a) facilitate productive planning and debriefing conversations with teachers, (b) notice salient CFC practices and their impact on teachers' thinking, and (c) use evidence of teacher learning to make decisions about their own coaching practices. All activities were fully online and included three parts: (a) five 2-hour synchronous course sessions, (b) eight video coaching clubs, and (c) two mentor-supported CFC cycles. The course sessions focused on concepts and practices for facilitating the three phases of a CFC cycle (Callard et al., 2022; West & Cameron, 2013). The video coaching clubs aimed to grow participants' abilities to notice and interpret coaching moves and teacher thinking in video clips of CFC conversations. The mentor-supported CFC cycles involved each participant working individually with a mentor–coach to prepare for and reflect on a CFC cycle with a mathematics teacher.

The study described in this paper extended research and professional learning activities beyond the initial project. These extended professional learning activities provided previous project participants with the CFC implementation framework as they engaged in a CFC cycle with a teacher in their local area. The extended research activities examined how the CFC framework supported these coaches' professional growth when facilitating CFC cycles.

First, all participants took part in a preparticipation interview, which included questions about participants' background experiences with coaching and a series of questions exploring their experiences and beliefs about each part of a CFC cycle. Next, participants engaged in a 90-minute online professional learning session in which project personnel introduced participants to the CFC implementation framework. During this session, participants were invited to discuss their initial reactions to the framework, describe how the framework related to their prior learning and current coaching, and consider implications of use of the framework on their future practice. Additionally, project personnel shared parameters and directions for a coaching cycle, which stipulated the coaching cycle needed to include a planning and debriefing conversation lasting at least 30 minutes and a lesson implementation in which the coach and teacher could coteach the lesson. Study participants were then asked to facilitate a CFC cycle with a teacher in their context using the CFC implementation framework as the primary tool to guide their preparation and facilitation. Participants also were asked to share any artifacts that captured their planning process for planning and debriefing conversations. However, there were no expectations or instructions for how participants should plan or what they should create in preparation for the CFC cycle. Finally, we encouraged study participants to ask teachers to bring a rough draft of a lesson plan or math task, along with mathematical learning goals for students and an instructional goal for themselves, to their planning conversations.

Participants

Nine coaches from the initial 2-year professional learning project participated in this study. Study participants had varied levels of coaching experience (2–15 years) and held various full-time positions in K–12 schools but were classified in two ways: (a) practicing mathematics coaches employed by a single school, school district, or regional organization with full-time release to work one on one with teachers or (b) classroom teachers who engaged in coaching work with colleagues as part of additional teacher leadership roles. We noted participants without full-time release from teaching likely had less time for planning and preparing for coaching interactions than participants with full-time release from teaching, a point to which we return when discussing implications of the findings. Table 1 displays participants' years of coaching experience, teaching experience, and role at the onset of the project; all names are pseudonyms.

Table 1
Participant Demographics

Participant	Coaching experience (years)	Teaching experience (years)	Role
Howard	15	5	Full-time coach in a single school
Logan	12	3	Full-time coach in a region
Arnold	7	13	Full-time coach in a school district
Clark*	6	17	Classroom teacher engaging in coaching
Bell	4	17	Full-time coach in a single school
Haynes*	3	33	Classroom teacher engaging in coaching
Peters	3	31	Full-time coach in a region
Vargas*	3	20	Classroom teacher engaging in coaching
Briggs	2	4	Full-time coach in a region

Note. *All years of coaching experience were not mutually exclusive from the years of teaching experience.

Data Collected

Primary data collected for the study were responses from semistructured interviews conducted after participants facilitated their full coaching cycle. Interviews consisted of questions asking participants to reflect on each of the three phases of their coaching cycle and share perceptions about how the CFC implementation framework may have influenced their coaching in each phase. For example, when discussing the planning conversation, participants first provided a summary of their overall experience during the planning conversation. Next, participants described how they used the CFC implementation framework to prepare for and facilitate their planning conversation. Finally, participants identified two moments in their planning conversation they found particularly productive. For each productive moment they shared, they included what made the moment productive and how the framework may have contributed to the moment. Participants then shared related comments for the lesson implementation and debriefing conversations from their coaching cycles. Participants also completed a postcoaching cycle survey in which they were asked to provide feedback on the framework. Survey data were not used to respond to the research question and instead were used to refine the CFC implementation framework further.

Data Analysis

Our team of four researchers qualitatively examined coaches' perceptions of how the framework supported them throughout their CFC cycle. To begin the analysis, two of our team members individually wrote low-inference paraphrases of all participants' responses and then met to reach consensus about an accurate paraphrase (Corbin & Strauss, 2014). Next, all four researchers met to distill paraphrases into prominent themes that emerged across participants' responses. Because our goal was to understand how the framework supported coaches during their CFC cycle, we only included paraphrases in which coaches communicated a connection between their coaching and their use of the framework. Three themes emerged during this second layer of analysis, which are presented in the following section. For the postcoaching cycle surveys, two members of our team read all participant responses and considered the feedback to make adjustments and final revisions to the CFC implementation framework. Survey responses were used to refine the framework and were not analyzed to answer the research question.

FINDINGS

Our analysis of participants' postcoaching cycle interviews and surveys revealed three interconnected themes involving coaches' perceptions of professional growth because of engaging with the framework during their CFC cycles. First, coaches detailed ways the framework supported them to intentionally plan and prepare for the three distinct phases of the CFC cycle. In a second theme, coaches described how intentional preparation using the framework facilitated improvements in responsive, "in-the-moment" decision making during planning, lesson implementation, and debriefing interactions. Coaches connected these improvements in their responsive decision making to using the framework to prepare for coaching interactions. In a third theme, coaches shared how using the framework led to powerful interactions with teachers, which in turn catalyzed new insights about coaching. We considered such insights as comments that transcended the single coaching cycle in this study as participants made connections between their use of the framework and their prior or future coaching practices.

Theme 1: Planning and Preparing for Phases of Coaching Cycles

All nine coaches reported various ways in which the framework supported them effectively in creating an intentional plan for the planning, lesson implementation, and debriefing phases of their coaching cycle. Amid this variety of responses, one central pattern was that all nine coaches used the different elements of the framework to create personalized and practical tools to guide their planning and debriefing conversations. When introducing the framework to coaches initially, we instructed them to use it to plan for their cycle interactions and to share any artifacts they created when preparing, which could include something as simple as handwritten notes. However, all nine coaches produced unique and comprehensive tools to guide their conversations, weaving together elements of the framework with their individual coaching practices skillfully. These actions exceeded our expectations, given that we did not recommend the level of specificity the coaches provided, nor did we ask coaches to generate their own unique coaching tools for planning and debriefing conversations. To create these tools and plans for their interactions, most coaches described first reviewing the framework broadly and then creating an outline for an upcoming conversation that mirrored the structure of the framework in terms of major focal topics. Then, coaches lifted specific questions from the framework to their personal tools based on the anticipated needs of the teacher. For example, Clark shared the following about how they created their conversation tool:

> *I typed up an outline of what to do, but I had the framework right next to me as I was doing that. So, I went through it all and made sure I would ask about the student learning goal, like you suggested, the instructional goals, what our model for coteaching was, how we want the students to be engaged. I also made sure we looked at the math problems . . . Then I added specific questions to ask, which I took right from your framework.*

Haynes similarly shared that they created an overarching plan for both their planning and debriefing conversations, using each row in the framework as a section on their personal conversation tool. Additionally, Haynes shared that they used the Peak Performance section to consider their overarching goals for themself and the teacher and the Next Steps section to select questions to ask based on their prior knowledge of the teacher. Haynes shared:

> *I looked at the peak performance pieces to think about, "What do we want as an outcome beyond just this one experience?" This included thinking about myself and what I needed to do well as a coach. I then looked specifically at that middle piece, next steps, and I highlighted questions that I wanted [the teacher] and I to work off of. That was a wonderful help and supported us to be very focused in our discussion.*

Each of the nine participants also shared that the framework supported dialogue in the planning conversation about intentionally selecting coteaching roles with the teacher for lesson implementation. To illustrate this trend, we highlight the actions of Logan, who shared a visual of the continuum of teaching responsibility (Gillespie & Kruger, 2022) with the teacher during the planning conversation and used the framework to facilitate discussion about which forms of coteaching would be most beneficial. Logan shared:

> *[The coteaching portion of the framework] offered a lot of clarity about the continuum of teaching responsibility . . . I said, "Here's this continuum," and I asked, "Where would you like my responsibility to be during the lesson?" [The teacher] could point and describe what she wanted from me. Then we were able to dive into the actual language in the framework about the "notice and confer" and "notice and bookmark" and kind of say, "Okay, so if I'm noticing and conferring, this is what would happen." And then I was able to ask her, "What would you like me to bookmark? Your goal is to ask better thinking questions, so do you want me to bookmark the questions you ask?" It felt really productive in the planning because the framework and the visual helped me to know my role and responsibility. And I think it helped her be really clear about what she wanted from me.*

Beyond the trends for all nine coaches of creating conversation tools and preparing for coteaching roles, coaches also shared additional perceptions, unique to individual or small groups of coaches, about ways the framework supported their preparation efforts. For example, Briggs and Vargas both shared that they spent time anticipating teacher thinking and planning possible responses to their anticipated thinking. Arnold, Briggs, and Vargas reported using the framework to engage in preplanning interactions with teachers. In short, all coaches shared how the framework supported them to create personal conversation tools and collaboratively prepare for coteaching the lesson.

Theme 2: Responsive Decision Making

A second theme, reported by all nine coaches, was that the framework effectively supported them in making productive, in-the-moment decisions that were responsive to teachers' learning needs. Examples of these decisions varied for each coach and traversed the planning, lesson implementation, and debriefing phases of the coaching cycles uniquely. For example, Bell talked about how the framework supported him in pacing both planning and debriefing conversations in a fixed amount of time. Briggs and Peters recounted making intentional decisions about coteaching, informed by the framework, during lesson implementation. Clark described using various moves from the framework to sustain an in-depth planning conversation about specific strategies to support students with productive struggle.

Across these differences, all nine coaches described instances in which their preparation using the framework helped them deepen planning discussions about the purpose of teaching mathematical content, how to respond to anticipated student strategies, or the rationale for instructional decisions. For example, Howard shared that they prepared a list of possible questions they might ask the teacher about anticipated student strategies despite "not being a huge fan of having a list of questions to ask somebody." During the planning conversation, Howard described how they pressed the teacher to think more deeply about possible student strategies using these prepared questions. Howard shared:

> *We were anticipating some student work . . . and she was describing what she thinks kids will do. I was able to ask, "What does it look like when you say this? What do you mean? What does that mean when this happens?" I think that was productive for us. It really helped us kind of decompose the task into where would that cognitive effort be needed for kids.*

Haynes shared a similar story. Prior to her planning conversation, she prepared a series of "why" questions to help the teacher think more deeply about various lesson design decisions. Haynes shared:

> *We were very happy with [the lesson plan] and how we would assess what students learned. We got into the nitty gritty of how we were going to teach the lesson. But it came back to the "whys" of the lesson. That was a big piece of our planning. Being able to ask questions about our decisions like, "Why is this content important?" This got us into mathematical discussion that the why of this lesson was really to be able to discover a property and then be able to use it to solve problems. "Why are we doing groups in this way? Why are we choosing this lesson format?"*

In both cases, Howard and Haynes shared stories representative of those found in the perceptions of all nine coaches. The framework first supported coaches to create a broad structure for their conversations along with possible questions to ask in different phases in the conversations. Such support, in turn, supported coaches to act responsively during various moments, using questions to facilitate deeper discussion about planning decisions.

We also identified this theme in coaches' descriptions of their lesson implementation, as five coaches reported improved preparation translated into improved decision making when collaboratively teaching the lesson. Briggs shared:

> *There was a time in the lesson where kids were not progressing from one model representation to the next in the way that we hoped. We both kind of recognized this was happening. And so, with maybe 13 minutes to spare, we decided together to pivot the lesson. And that completely changed the students' feeling from "I'm starting to be frustrated" to "I have tools." As a result of that pivot, I think students really had the opportunity to dig into the math and really be engaged with it. If we had not had that content focus in the planning session, not done the math or anticipated strategies, we would not have been prepared to recognize that that pivot needed to happen. I also think that I was ready to do a notice and confer. The framework definitely helped make that pivot happen.*

In this instance, Briggs attributed a successful, in-the-moment decision to collaboratively adjust the lesson to two preparation activities involving the framework. First, Briggs and the teacher engaged in a planning conversation about the mathematical content and possible student strategies, which supported them in effectively noticing student thinking during lesson implementation. Second, Briggs shared the framework prepared him to notice and confer (Gillespie & Kruger, 2022), 1 of 4 options for coteaching, which Briggs selected in that moment, allowing the coach and teacher to share observations and make a quick decision to adjust the lesson.

Theme 3: New Insights About Coaching

The third theme highlighted that 5 of 9 coaches reported gaining new insights, or "ah-ha moments," about coaching. We considered insights about coaching to be statements that made connections between the ideas in the framework and either the coaches' prior experiences or the coaches' practice in future coaching cycles. In each instance of insight, coaches reported that the framework supported them to experiment with a new coaching action, and the resulting interactions with teachers triggered new ideas about their coaching practice. To illustrate how the framework supported new coaching behaviors, which translated into new insights, Briggs, Haynes, Howard, and Vargas reported the framework sparked a realization regarding the potential of reflective discussion after a lesson to support teacher growth. For example, Howard stated:

> *I have not been intentional about asking teachers, "How are you planning to incorporate this into your typical practices now?" Because I had the framework, that became very intentional on my part, and it hasn't always been in the past. And I can see now why that's so important. . . . I think a lot of times teachers reflect on what they could have done differently or what kids might have learned or didn't learn, and how they might go about addressing it. But I think a big part of it for [the teacher] was really thinking about what she learned. This got cemented in my head as far as what's important.*

Similar, Vargas shared:

> *The implications section in the debrief part of the framework, I feel like that's important. It made me realize that a major goal of ours as coaches is to make sure that the teacher carries this practice forward. That it doesn't just stop because you're not there in the classroom.*

In both examples, Vargas and Howard shared how the implications section of the debriefing conversational structure component of the framework prompted them to implement new coaching behaviors; the resulting experiences illuminated how prompting teachers to consider implications for their future teaching is a critical coaching move.

Briggs shared a different realization regarding how the examination of specific student thinking during a debriefing conversation, as prompted by the framework, can have a significant impact on teacher learning. Briggs shared:

> *We talked about the student who was visibly changing her math mindset during class. I had bookmarked a moment involving a student that is classified as special education. We talk about how this student was not only keeping up with the lesson but also making conclusions that other students were not. We spent a lot of time talking about that. "Why did this happen? What were the contributing factors? What made this happen? How can we do this again in the future?" He got kind of emotional, in a good way. And he started to tear up and said, "This is the first time I've seen my kids wanting to do math and being that engaged and being that open and willing to share what they were thinking. This was totally transformative; it was the best lesson I've ever been a part of." I just can't even tell you how awesome it was. Here I am thinking, "We screwed up," and he's saying, "Wow, this was transformative for my kids." So, I can see from the framework that, honestly, this came from looking carefully at student evidence and then considering contributing factors.*

Although most new coaching insights centered on the debriefing conversations, Logan reflected about the power of asking teachers "why" questions from the framework during planning conversations. Logan shared:

> *Talking more about "the why" was powerful. Why are we going to teach the lesson the way we were going to do it? It felt productive because it helped her refer back to the goals for the students. . . . We were able to talk about, "Does this actually meet our learning goals and the instructional practice goals?" We could really be intentional about the time we were going to spend in the lesson. It felt productive to me because now we weren't just wasting time and, you know, that's a big thing teachers say: "I don't have enough time." So, we could really be intentional about every decision we are making for the lesson. . . . Without the framework, I don't think I would have spent that time in the planning session doing that.*

In this example, Logan shared how the "why" of the planning conversation component of the framework supported them to consider planning decisions carefully in relation to the learning goals for students and instructional practice goals for the teacher. Logan also shared how the "why" questions on the framework helped them and the teacher to coconstruct a lesson that used limited instructional time, which was a challenge she had often encountered when working with teachers.

Taken together, these examples illustrate how the framework supported coaches to purposefully plan and prepare for their coaching cycle; improve their responsive decision making in their planning conversations, lesson implementation, and debriefing conversations; and gain new insights into their work as coaches. Furthermore, these insights primarily involved debriefing conversations but also included examples from the planning conversation and lesson implementation phases of the coaching cycle.

DISCUSSION

This study aimed to understand how a CFC framework influenced coaches' professional growth with respect to facilitating one-on-one coaching cycles. Through our analysis of coaches' perceptions when using the framework with teachers, we found the framework supported coaches to prepare for and act responsively during CFC cycle interactions. Furthermore, findings showed over half of participants shared new insights about coaching that transcended the coaching cycle they facilitated for this study. In the following section, we describe how our framework and study provided two key contributions to the field of mathematics education.

CFC Implementation Framework

The first contribution is the CFC implementation framework, a practical tool for any mathematics coach, specialist, or teacher educator engaging teachers in collaborative planning, coteaching, and debriefing interactions. The framework was constructed through a robust process that merged our extensive experience coaching teachers and coaches with theoretical structures underpinning the three phases of a CFC cycle. This process included iterative cycles of drafting and revision based on feedback among our team of project researchers, who were actively analyzing mathematics coaching, and external reviewers whom we sought out because of their expertise in the field. The final round of feedback and revision occurred with practicing coaches (i.e., our study participants) as they used the framework in coaching cycles with teachers in their local settings. This feedback and our findings, which were grounded in participants' stories from using the framework in the field, provided evidence that the framework supported professional improvements in coaches' abilities to facilitate CFC cycles.

Beyond the robust construction process, our framework has at least three characteristics that make it a unique extension of existing protocols, structures, and frameworks that have similarly intended to support coaches in acting intentionally, yet responsively, when supporting teachers. Our framework (a) provides specific and actionable behaviors that align with the three distinct phases of a coaching cycle; (b) articulates connections between these three phases, so coaches recognize the components of a coaching cycle are a coherent set of learning experiences; and (c) applies directly to coaching cycles in which the primary goal is improving teachers' content and pedagogical content knowledge. Our CFC implementation framework builds on prior tools that contain subsets of these three characteristics. For example, Wills and Rawding (2019) created protocols to help coaches set goals with teachers for future interactions. Baker and Knapp (2019, 2023) developed a protocol that is inclusive of coaching cycles while extending beyond this single coaching activity. The protocol is a tool that supports coaches in planning and reflecting on coaching interactions aimed at supporting teachers in the implementation of ambitious and equitable teaching practices (NCTM, 2014). These tools articulated specific and actionable behaviors, yet they were not connected to CFC cycles. Knight (2007) and Costa and Garmston (2016) have provided structures to guide coaches to facilitate all three phases of a coaching cycle that align to the principles of instructional and cognitive coaching, respectively. However, the conversational structures in these models did not target improving teachers' content and pedagogical content knowledge and instead aimed to cultivate general instructional habits and cognition. West and Cameron (2013) described CFC cycles as a tool to improve teachers' content and pedagogical content knowledge; however, they did not provide a comprehensive set of actionable practices to guide coaches through all three phases of the coaching cycle.

Coach Learning

As a second contribution to the field of mathematics education, our study provides new insights into how coaches learn to coach, with a focus on how a coaching tool (i.e., our framework) supported professional growth. Research on professional development for mathematics specialists (Jarry-Shore et al., 2023; Swars Auslander et al., 2023) and coaches working one on one with teachers (Gibbons & Cobb, 2016; Saclarides & Kane, 2021; Saclarides & Kane, 2024) remains an emerging focus. Coaches often have been "anointed and/or appointed" (Fennell, 2017, p. 9) without ongoing professional learning. Findings from our study build on prior studies of coach learning, such as those from Stein et al. (2022) and Kane and Saclarides (2022), who have investigated how specific professional learning activities influenced coaches and their practices and called upon future researchers to investigate coach learning. In response, our study generated new knowledge about how a coaching tool, as opposed to a set of professional learning activities, supported coaches' professional growth in facilitating coaching cycles. Our findings connected closely to those of Baker and Knapp (2019), who showed a coaching protocol improved content-focused coaches' abilities to plan for and reflect upon coaching interactions. As in Baker and Knapp's study, our participants also reported improvements in their abilities to plan and prepare for all three phases of the coaching cycle. We found the framework supported coaches' abilities to make responsive decisions during coaching interactions and triggered new insights about the larger goals of coaching.

To illustrate this claim, we synthesize experiences shared by Briggs across the full coaching cycle. Recall that Briggs described how the planning portion of the framework prepared the coach and teacher to adjust the lesson responsively based on observations of student thinking using a notice and confer coteaching move. Then, Briggs shared how the debriefing portion of the framework helped the coach prepare for and facilitate a debriefing conversation centered around analyzing evidence of student thinking. This conversation supported the teacher to have transformative realizations about students' capacities to think and reason and the use of more equitable mathematics teaching practices (NCSM, 2019; NCTM, 2014). In response, Briggs described his own realization about coaching, catalyzed from use of the framework, regarding the power of examining interplay between student thinking and instructional decisions during debriefing conversations.

Implications and Future Directions

This study holds implications for both practitioners and future research. For practitioners, our framework is a practical tool that articulates specific and actionable behaviors for any mathematics coach, specialist, or teacher educator wanting to develop teachers' mathematical content and pedagogical content knowledge through collaborative planning, lesson implementation, and debriefing interactions. Based on findings and professional learning experiences, we found the framework supported professional growth for a group of coaches with varied levels of coaching experience and diverse roles, including coaches with limited release time from teaching for coaching colleagues. We encourage any practitioner who supports mathematics teachers through one-on-one interactions to consider adopting our framework into practice.

However, we also found all participating coaches, regardless of their prior coaching experience, discussed the connected nature of their own professional learning experiences and framework use. Coaches' perceptions suggested understanding the guiding principles of CFC and theoretical structures underpinning the framework phases appeared to be prerequisite knowledge for effectively engaging with the framework. Using the framework also supported participating coaches in deepening their understandings of these principles and structures. Thus, for leaders interested in using the framework to support the learning of mathematics coaches and specialists, we recommend designing experiences to help coaches develop at least a basic understanding of principles and theoretical structures in the framework. Then, coaches would benefit from opportunities to use the framework with teachers to continue to deepen this understanding of CFC concepts. For example, district leaders responsible for coaching teams might structure a series of collaborative learning sessions to unpack the structure and individual elements of a particular phase of the framework. Then, they might encourage coaches to plan for and use that phase of the framework when working with teachers and follow up with collaborative discussions to reflect on their coaching experiences. It is plausible that, based on our findings, such actions from district leaders could improve coaches' abilities to facilitate CFC cycles and deepen their understandings of coaching. Additionally, such learning opportunities might also naturally catalyze discussion about inherent challenges in coaching not explicitly addressed in the framework (e.g., ways to manage power dynamics in coaching relationships through balancing directive and invitational discourse moves; Gillespie et al., 2025; Smith et al., 2025; Witherspoon et al., 2021).

Our findings also suggest new research questions about how coaching tools (e.g., frameworks, protocols) influence coach development. For example, future researchers should examine features of coaching tools that make them productive and practical resources. Although it was not the primary focus of our analysis, multiple coaches mentioned framework features that increased the usability of the tool. These features may provide a starting point for other researchers and professional learning specialists interested in coaching tools. For example, participants highlighted the power of pairing visual, theoretical structures with specific and actionable coaching behaviors. Across the three themes of our findings, coaches continually mentioned connections between structures, such as the Guide to Core Issues (West & Cameron, 2013), the continuum of teaching responsibility (Gillespie & Kruger, 2022), and the debriefing conversational structure (Gillespie et al., 2023), along with specific behaviors to enact the structures played a key role in supporting growth.

As a second example, multiple coaches referenced how the framework's inclusion of first steps, next steps, and peak performance played distinct yet interrelated roles when they interacted with the framework. Coaches shared that the first steps and next steps provided more immediate and actionable guidance for each phase of the coaching cycle, whereas the peak performance descriptors helped coaches consider the overarching purpose of their interactions with teachers and set personal coaching goals. Thus, future researchers who establish new tools might consider ways to couple short-term behaviors with long-term outcomes to support coaches with limited time to prepare for coaching interactions.

Third, coaches consistently referenced how the framework helped them view a coaching cycle as a coherent whole, comprised of three interconnected phases. Furthermore, coaches mentioned having separate guidance for each of the three phases was productive because descriptions made explicit connections between the phases—another important consideration for future coaching tools. In sum, these three features appear to unveil practical actions and larger coaching concepts for participating coaches simultaneously, and we encourage future researchers to follow this initial path, examining what features make coaching tools useful.

Future research is also needed to understand better the interplay between professional learning experiences and coaching tools. In this study, participants had 2 years of learning prior to receiving the framework. Without this prior learning, we speculate our participants may not have been prepared to use the framework adequately and grow in the ways they reported. On the other hand, the same participants requested a comprehensive tool that summarized and operationalized their learning experiences (from the prior 2-year study) in ways that prepared them for real interactions with teachers. Thus, we conjecture high-quality professional learning for coaches involves collaborative experiences connected to practical tools. We encourage future research to investigate this relationship between learning experiences and tools with coach learning. Finally, the field would benefit from further research on ways this coaching tool may be applicable beyond mathematics education or one-on-one coaching. It is possible the framework could be used in diverse contexts in which one educator strives to help fellow educators build their content and pedagogical content knowledge. For example, Kraft and Blazar (2018) raised the possibility of coaches working with small groups of teachers to address scalability issues inherent to one-on-one coaching. We can envision how a coach might use the framework to facilitate content-focused planning and debriefing conversations with small groups of teachers around a shared lesson in addition to engaging in one-on-one coaching

cycles. Although such use would likely require modifications and is beyond the findings of our analysis, we encourage both practitioners and researchers to explore use of our CFC implementation framework in a wider variety of contexts.

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Appendix: Content-Focused Coaching Implementation Framework

Content-Focused Coaching Implementation Framework

The material is based upon work supported by the National Science Foundation Grant #2006353 & #2006263. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Guiding Principle

Building from prior research and literature on coaching, the guiding principle for the design and implementation of our content-focused coaching model is as follows: *If coaches maintain an intentional focus on specific, high-leverage teaching practices during all coaching conversations and activities, they can reliably achieve positive outcomes related to teacher growth and student learning.*

These high-leverage teaching practices, components of ambitious and equitable mathematics teaching (Horn & Garner, 2022), include

- establishing mathematics learning goals focused on understanding big ideas in mathematics (Hiebert & Grouws, 2007),
- implementing high cognitive demand tasks that promote inquiry and provide access to all students (Smith & Stein, 2018),
- eliciting and responding to students' thinking (Leahy et al., 2005; Smith & Stein, 2018),
- facilitating meaningful and productive mathematical discourse that builds from students' reasoning and connects mathematical strategies and representations (Chapin et al., 2009; Smith & Stein, 2018; Staples, 2007), and
- supporting and promoting productive struggle (Kapur, 2010; Warshauer, 2015).

As a result, outcomes of content-focused coaching in mathematics are the development of a teacher's

- mathematical content knowledge (West & Cameron, 2013; West & Staub, 2003),
- pedagogical content knowledge (Ball et al., 2008; Shulman, 1987), and
- ability to use ambitious and equitable mathematics teaching practices (Lampert & Graziani, 2009).

Phase 1: Planning Conversation

Outcomes of Planning Conversations Related to the Guiding Principle

- Teacher can explain how their understanding of (a) mathematical content knowledge, (b) how students learn mathematical content, and (c) ambitious and equitable mathematics teaching grew as a result of the planning conversation.
- Teacher develops planning habits focused on (a) mathematical content, (b) how students learn mathematical content, and (c) use of ambitious and equitable mathematics teaching practices without the support of a coach.

Elements	First Steps	Next Steps	Peak Performance
Preparing for the Planning Conversation			
Preparing for Planning Conversation	Coach asks teacher to provide student mathematics learning goal(s) and lesson activities/tasks. Coach asks teacher to provide instructional goal for themself.	Coach: • asks teacher to anticipate student thinking and related responses by completing lesson activities/tasks themself as a learner. • anticipates student thinking and related responses by completing lesson activities/tasks themself as a learner. • designs plan for conversation including questions to ask the teacher.	Coach uses knowledge of the teacher, lesson activities, and goals to design plan for conversation. Coach anticipates teacher's responses to planned questions and prepares potential coaching moves.

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Elements	First Steps	Next Steps	Peak Performance
Discussing the *What, Who, How, and Why* of Lesson Design (West & Staub, 2003)			
***What:* Creating Mathematics Learning Goal(s) for Students**	Teacher or coach states the mathematics learning goal(s) for students.	Teacher and coach discuss: • ways to make goal(s) more focused on learning and understanding. • how lesson/task aligns with mathematical goal(s). • evidence of student thinking that would indicate goal(s) was/were met. • how goal(s) relate(s) to important mathematical ideas. • how goal(s) connect(s) to students' prior learning. how goal(s) of this lesson are part of a coherent set of learning experiences.	Teacher and coach discuss how *creating mathematics learning goal(s) for students* supports ambitious and equitable mathematics teaching and improves student learning. Teacher and coach discuss teacher's next steps in making *creating mathematics learning goal(s) for students* a planning habit.
***Who:* Anticipating Student Thinking**	Coach and teacher discuss anticipated student thinking, including possible strategies or related responses.	Teacher and coach: discuss how to productively build from and/or respond to anticipated student thinking. • use anticipated thinking to design or refine lesson activities. • discuss how anticipated thinking is evidence of progress toward mathematics learning goals.	Teacher and coach discuss how *anticipating student thinking* supports ambitious and equitable mathematics teaching and improves student learning. Teacher and coach discuss teacher's next steps in making *anticipating student thinking* a planning habit
***How:* Designing the Learning Experiences**	Coach and teacher engage in discussion about designing the learning experiences.	Coach and teacher discuss: how learning experiences connect to each other and to goal(s) for students, which may result in refining experiences, tasks, or goals. • how to begin each learning experience in ways that provide all students with access without declining the cognitive demand. • how students will engage in learning experiences and teacher's role in facilitating the experiences (e.g., providing independent thinking time, using discussion protocols in small groups). • how to summarize each learning experience by making student thinking visible to support all students in advancing toward mathematical goal(s). • how to assess student learning including artifacts to collect and examine in the debrief.	Teacher and coach discuss how designing the learning experiences supports ambitious and equitable mathematics teaching and improves student learning. Teacher and coach discuss teacher's next steps in making designing the learning experiences a planning habit.

Elements	First Steps	Next Steps	Peak Performance
Discussing the *What, Who, How, and Why* of Lesson Design (West & Staub, 2003)			
***Why:* Articulating Rationales for Planning Decisions**	Coach invites teacher to share rationales for certain planning decisions.	Coach embeds frequent questions to: support teacher to consider affordances and drawbacks of their planning decisions. • support teacher to make connections between the *what, who, and how* components of lesson design.	Teacher and coach discuss how *articulating rationales for planning* decisions supports ambitious and equitable mathematics teaching and improves student learning. Teacher and coach discuss teacher's next steps in making *articulating rationales for planning* decisions a planning habit.
Creating Goal(s) for the Teacher			
Creating Instructional Practice Goal(s) for the Teacher	Coach invites teacher to share rationales for certain planning decisions.	Coach and teacher discuss: how to refine instructional goal(s) so it/they is/are sufficiently specific to reflect upon in the debrief. • evidence of both student and teacher actions that would indicate progress toward teacher's instructional practice goal(s). • how the lesson/task affords opportunities to use practices related to goal(s) for the teacher. • why the goal(s) is/are high leverage and how this/these goal(s) will support student learning of important mathematical content.	Teacher and coach discuss how *creating instructional practice goal(s) for the teacher* supports ambitious and equitable mathematics teaching and improves student learning. Teacher and coach discuss teacher's next steps in making *creating instructional practice goal(s) for the teacher* a planning habit.
Preparing for Lesson Implementation			
Preparing for Coteaching	Coach asks teacher how they would like to coteach the lesson during planning conversation.	Coach and teacher consider four forms of coteaching (see Phase 2: Lesson implementation) to design plan for lesson implementation that assigns teaching responsibility for each lesson activity.	Coach and teacher consider four forms of coteaching (see Phase 2: Lesson implementation), teacher's instructional goals, and teacher's learning needs to design plan for lesson implementation that provides coach and teacher with a clear understanding of their roles for each lesson activity. Coach and teacher are prepared for "in-the-moment" decisions and adjustments based on teacher's and students' learning needs.

Phase 2: Lesson Implementation			
Outcomes of Lesson Implementation Related to the Guiding Principle Teacher is intentionally supported by coach to experiment with new instructional practices related to (a) implementing lessons focused on important mathematical concepts, (b) noticing and responding to how students are learning mathematical content, and (c) ambitious and equitable mathematics teaching. • Coach and teacher execute a coteaching plan that allows for collaborative decisions to fluidly shift between forms of coteaching in response to in-the-moment opportunities and the teacher's instructional goal and emotional needs.			
Elements	**First Steps**	**Next Steps**	**Peak Performance**
Using the Four Forms of Coteaching (Gillespie & Kruger, 2022)			
Model	Coach models portion of lesson while teacher observes.	Coach finds moments while modeling to make their decision-making process explicit with teacher. • Coach and teacher find opportunities to discuss what they notice about student thinking. • Coach provides teacher with opportunities to retake responsibility of the teaching.	Coach models lesson in ways that draw attention to aspects of practices related to teacher's learning needs and instructional practice goals. Coach and teacher find opportunities to listen to each other's noticings about student thinking, and coach makes instructional decisions based on these shared noticings.
Enter and Exit the Lesson	Coach enters and exits moments in the lesson.	Coach intentionally enters and exits moments in the lesson to draw attention to aspects of practices • Coach is mindful about how they enter the lesson and for how long they maintain teaching responsibility.	Coach intentionally enters and exits critical moments in the lesson to draw attention to aspects of practices related to teacher's learning needs and instructional practice goals. Coach enters the lesson for smallest amount of time needed to draw attention to important aspects of practice. Coach uses knowledge of teacher to enter the lesson safely (without causing interruption) and fluidly returns teaching responsibility to teacher when exiting.
Notice and Confer	Coach records noticings and confers with teacher at various moments in the lesson.	Coach (a) notices particular students' thinking and aspects of teacher's instructional practice and (b) confers with teacher at various moments in the lesson. • Coach and teacher find opportunities to listen to each other's noticings about student thinking.	Coach (a) intentionally notices students' thinking and attends to relationship between students' thinking and instructional practices and (b) confers with teacher at critical moments in the lesson that address teacher's learning needs and instructional practice goals. Coach and teacher find opportunities to listen to each other's noticings about student thinking, and teacher makes instructional decisions based on these shared noticings.

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Elements	First Steps	Next Steps	Peak Performance
Using the Four Forms of Coteaching (Gillespie & Kruger, 2022)			
Notice and Bookmark	Coach notices and bookmarks lesson events at various moments in the lesson.	Coach (a) notices particular students' thinking and aspects of teacher's instructional practice and (b) bookmarks moments in the lesson. Coach bookmarks lesson events using details that allow the events to be accurately recalled during the debrief.	Coach (a) intentionally notices students' thinking and attends to relationship between students' thinking and instructional practices and (b) bookmarks critical moments in the lesson that address teacher's learning needs and instructional practice goals to discuss in the debrief conversation. Coach bookmarks lesson events using details that allow the events to be accurately recalled during the debrief as evidence of progress toward goals for both students and teacher.

Phase 3: Debriefing Conversation

Outcomes of Debriefing Conversations Related to the Guiding Principle
Teacher can explain how their understanding of (a) mathematical content knowledge, (b) how students learn mathematical content, and (c) ambitious and equitable mathematics teaching grew as a result of the entire coaching cycle.
Teacher can transfer new understanding of (a) mathematical content knowledge, (b) how students learn mathematical content, and (c) ambitious and equitable mathematics teaching to support growth in future practice.

- Teacher develops reflective habits focused on (a) mathematical content, (b) how students learn mathematical content, and (c) use of ambitious and equitable mathematics teaching practices without the support of a coach.

Elements	First Steps	Next Steps	Peak Performance
Preparing for the Debriefing Conversation			
Preparing for Debriefing Conversation	Coach reviews goals established during planning conversations. Coach reviews notes about observed events during coteaching.	Coach designs a plan for the debriefing conversation that accounts for goals for students and goal for teacher established during planning conversation and observed events during coteaching. • prioritizes moments from coteaching to highlight (a) evidence of students' mathematical thinking or (b) factors that supported or limited progress toward the goals. • includes questions to ask teacher that elicit teacher reflection.	Coach designs plan for debriefing conversation that integrates mathematical goal(s) established during planning conversation and observed events during coteaching to support teacher to transfer new learning to future practice. When designing plan for the conversation, coach prioritizes moments from coteaching that (a) highlight evidence of student thinking, (b) showcase factors that supported or limited progress toward goals, and (c) inform future practice. Coach anticipates teacher's responses to planned questions and prepares potential coaching moves.

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Elements	First Steps	Next Steps	Peak Performance
Reflecting on the Lesson Using the Debriefing Framework (Gillespie et al., 2023)			
Revisit Goals	Coach reminds teacher about goal(s) for students and goal(s) for teacher established during planning conversation.	Coach and teacher discuss mathematics learning goal(s) for students and instructional practice goal(s) for teacher to ensure shared understanding.	Coach and teacher make connections between mathematical learning goals, evidence of student thinking, and contributing factors to identify important and specific implications for teacher's future practice. Coach and teacher coconstruct next steps that support the teacher to embed new learning in their regularly occurring practice.
Analyze Evidence From Students	Coach and teacher discuss instances of student thinking using artifacts such as student work or observation notes.	Coach and teacher: • discuss how the evidence of student thinking connects to the mathematical learning goals. • use evidence of student thinking to collaboratively make and support claims about student understanding.	
Consider Contributing Factors	Coach and teacher discuss features of lesson design and implementation that may have contributed to student understanding of mathematical learning goals.	Coach and teacher: • discuss connections between evidence of student thinking and features of lesson design and implementation. • collaboratively make and support claims about how features of lesson design and implementation supported or limited success toward goals.	
Determine Implications for Future Teaching	Coach asks teacher what they learned from preceding discussion that will inform teacher's future practice.	At multiple points throughout the conversation, coach and teacher consider how ideas being discussed will inform future practice. • Coach invites teacher to share actions they will take to enact their new learning.	

Elements	First Steps	Next Steps	Peak Performance
Concluding the Coaching Cycle			
Reflecting on Coaching Cycle Process With Teacher	Coach asks teacher to share their thoughts about coaching cycle process.	Coach and teacher consider ways to improve future coaching interactions.	Coach and teacher collaboratively name aspects of coaching cycle process that were beneficial, or in need of improvement, to guide future coaching interactions. Coach reflects on and records ideas from process reflection conversation and uses these ideas during future coaching work.
Planning for Future Coaching With Teacher	Coach and teacher discuss and/or schedule future coaching work.	Coach and teacher anticipate teacher's needs for continued growth as they experiment with new practices.	Coach and teacher collaboratively create plan for future coaching based on teacher's new learning and anticipated needs for continued professional growth. Coach records and uses ideas from this discussion to create connections between current and future coaching work.
Individual Reflection	Coach takes time to individually reflect on effectiveness of their coaching during the cycle.	Coach reflects on: • evidence of teacher learning. • how their coaching supported or limited teacher learning during the cycle.	Coach uses their individual reflection to determine next steps to continue growing their coaching practice.