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1-2023

## Sustaining at Scale: District Mathematics Specialists' Adaptations to a Teacher Leadership Preparation Program

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# Sustaining at Scale: District Mathematics Specialists' Adaptations to a Teacher Leadership Preparation Program

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## Abstract

A common approach to scaling up a professional development program is for the researchers who designed the program to prepare teacher leaders to facilitate it at their schools. When researchers eventually leave, however, teacher leaders may receive less support. To ensure that teacher leaders continue receiving support, researchers can prepare district mathematics specialists to assume responsibility for preparing the teacher leaders. Little is known, however, about district mathematics specialists' role in sustaining, and potentially adapting, professional development programs. We examined district mathematics specialists' facilitation of an adaptive teacher leadership preparation program. Program sessions were originally facilitated by researchers then by the specialists. We analyzed the adaptations specialists made to the sessions over four years and the rationales underlying these adaptations. Specialists maintained the program's overall structure, continuing to model the facilitation of core program activities that teacher leaders would then facilitate in their site-based professional development workshops. However, they modified the thematic focus of these activities to address district goals, interests, and priorities. Adaptations were informed by specialists' intimate knowledge of what was occurring in district schools. This approach maintained activities supportive of teacher learning, but also demonstrated that the specialists took increasing ownership over the program by adapting it.

**Keywords:** facilitator preparation, mathematics education, professional development, teacher leader, scale

**Author Note:** We have no known conflict of interest to disclose.

Continued professional development for teachers is needed in order to enhance classroom instruction and students' opportunities to learn mathematics (Even, 2008; Jacobs et al., 2017). To meet this need, there have been calls to scale up professional development (PD) programs (Roesken-Winter et al., 2015). One approach to offering PD to large numbers of teachers is for the researchers who designed a PD program to prepare teacher leaders to facilitate the PD at their schools (Borko et al., 2011). A drawback to this approach is that, when the researchers eventually leave, teacher leaders may no longer be supported to the same degree and new teacher leaders may receive less support than their predecessors in preparing for the role. To address this issue, district mathematics specialists can be prepared to assume responsibility for preparing teacher leaders. Little is known, however, about the specialist's role in sustaining PD initiatives or their impact on teacher leaders' learning (Jackson et al., 2015; Krainer, 2015).

We studied a research practice partnership between our research team and a large, metropolitan school district, whose aim was to build district capacity to provide PD to middle school mathematics teachers, at scale. Two programs were central to this partnership: 1) the Problem-Solving Cycle (PSC) program of teacher PD and 2) the Teacher Leadership Preparation (TLP) program of teacher leadership development (Borko et al., 2015). In the TLP, facilitator educators

prepare teacher leaders to facilitate PSC PD workshops with teachers at their schools. Specifically, they model the facilitation of core activities that are central to the PSC PD, then debrief their facilitation. Teacher leaders then facilitate these activities in site-based workshops.

In previous iterations of these two programs, researchers played the role of the facilitator educator, responsible for preparing teacher leaders through the TLP (Borko et al., 2015; Koellner et al., 2011). In the current study, this role was initially played by researchers, then increasingly played by district mathematics specialists, who adapted the core activities in the TLP over time.

The activities modeled for teacher leaders in the TLP are considered core activities, but are designed to be adapted to address the local context's shifting goals, interests, and priorities. Such adaptations can ensure that the work remains relevant as goals, interests, and priorities shift, but may also result in core activities supportive of teacher learning being lost. We examined the adaptations that district mathematics specialists made in modeling and debriefing their facilitation of core PSC activities for teacher leaders in the TLP program. We also examined the rationales underlying these adaptations. We addressed the following research questions:

1. How did district mathematics specialists adapt a teacher leadership preparation program devoted to preparing teacher leaders to facilitate site-based teacher PD?
  - a. What core activities, routines, and structures did they follow, modify, or omit?
  - b. What new activities did they create?
2. What were the rationales underlying district mathematics specialists' adaptations to the teacher leadership preparation program?

### **Conceptual Framework**

The conceptual framework for this study draws from literature describing: 1) the Problem-Solving Cycle and Teacher Leadership Preparation programs of practice-based professional learning and 2) adaptations to professional development programs. We first describe the PSC and TLP programs, as well as the theory of action underlying these programs. We then discuss literature on adaptations to PD programs and the potential effects of such adaptations.

#### **The Problem-Solving Cycle and Teacher Leadership Preparation Programs**

Several recent reviews of professional development research have noted the importance of situating teachers' professional learning opportunities in the practice of teaching (Darling-Hammond et al., 2017; Sztajn et al., 2017). For example, Darling-Hammond and colleagues noted that effective professional development "uses authentic artifacts, interactive activities, and other strategies to provide deeply embedded, highly contextualized professional learning" (p. v). Similarly, Ball and Cohen (1999) recommended that PD designers identify the central activities of teaching that will be the focus of the PD, select or create materials that document these activities, and then use the materials to create opportunities for teachers to learn the activities. In their model of practice-based PD, one core activity is the systematic study of teaching practice and student learning using records of practice such as student work, curriculum materials, and classroom videos. The Problem-Solving Cycle is a practice-based program of teacher PD, while the Teacher Leadership Preparation program is a practice-based program of facilitator PD.

There are two cycles to the Problem-Solving Cycle in a given school year. Each cycle centers teachers' learning around a focal mathematics task and consists of three professional development workshops, each focused on a core activity (Figure 1a). In the first workshop, the core PSC activity, Doing the Math, entails solving the focal task and preparing to teach it. During this activity, teachers may also examine students' written solutions to the task or compare multiple strategies and representations for solving it in what we call a *teacher analysis task*. Next, teachers teach the task and lessons are video-recorded. In the second and third workshops, the core PSC activity is a Video-Based Discussion (VBD), in which teachers view and discuss a clip from the video-recorded lessons. Discussions are guided by focal questions, which typically foreground student thinking in the second workshop and instruction in the third.

[Insert Figure 1]

The TLP program supports implementation of the PSC program at scale (Borko et al., 2015). In the TLP program, teacher leaders from participating schools meet three times per cycle for full-day TLP sessions (Figure 1b), in which they prepare to facilitate their upcoming PSC workshops with their site-based colleagues. The three TLP sessions in the first cycle of a school year are TLP 1-1, 1-2, and 1-3; the three sessions in the second cycle are TLP 2-1, 2-2, and 2-3.

TLP sessions are organized according to the Learning to Lead model (Figure 1c). In a given session, facilitator educators spend the morning modeling the facilitation of a core PSC activity (phase 1) then debriefing their facilitation of the activity with teacher leaders (phase 2). Teacher leaders then spend the remainder of the day planning their PSC workshops and rehearsing part of what they planned with others (phase 3). In phase 4, they conduct their site-based PSC workshops. For the current study, we focus on the modeling and debriefing phases.

We examined district mathematics specialists' adaptations to the modeling of two core PSC activities – Doing the Math and the Video-Based Discussion – as well as a third core activity, Debriefing the Facilitation. While teacher leaders go on to facilitate the former two activities in their PSC workshops, Debriefing the Facilitation only occurs at TLP sessions. All three core activities consist of structures and routines. Structures consist of materials used in an activity, while routines are the actions facilitators may take in facilitating an activity. For instance, in a VBD, norms for viewing and discussing a video-clip would be a structure, whereas showing the video-clip first without a focal question in mind would be a routine.

We chose to examine these three core activities given their documented impact on participants' learning. Participation in Doing the Math and VBDs is associated with growth in teachers' knowledge and practice (Elliott et al., 2009; Jacobs et al., 2014; Koellner & Jacobs, 2015; van Es & Sherin, 2010), whereas debriefing has been found to support teacher leaders' learning (Lesseiget al., 2017). As such, we anticipated that adaptations to these activities could be particularly consequential for teachers and teacher leaders, and thus important to understand.

According to our theory of action, TLP sessions should develop teacher leaders' knowledge and skill as PD facilitators, thus allowing them to offer rich PD for their colleagues. This PD should in turn develop teachers' knowledge and practice, resulting in improvements in student learning. Indeed, prior work (Jacobs et al., 2014; Koellner & Jacobs, 2015) found that teacher leaders who facilitated PSC workshops and teachers who participated in them improved their mathematical knowledge for teaching and instructional practices. Their students also did better on a standardized test than did students of non-participating teachers. In this study, district mathematics specialists took increasing responsibility for facilitating TLP sessions, thus sustaining the PD, and presumably, teacher leaders' growth. However, they also made many adaptations.

### **Adaptations to a Program of Professional Development**

Programs of professional development may exist on a continuum from highly specified to highly adaptive (Jacobs et al., 2017; Koellner & Jacobs, 2015). In the former, facilitators are asked to use existing materials and enact core activities and routines as designed, with few or no adaptations. In the latter, there are also core activities, structures, and routines, however, they are designed to be adapted to address the goals, interests, and priorities of the local PD context.

The PSC and TLP programs are highly adaptive. Facilitators are encouraged to modify each program's core activities, structures, and routines to fit their local context. Such adaptations can be structural or thematic, and can occur at a range of grain sizes. Moreover, facilitators are likely to have a variety of rationales for the adaptations they make to these programs.

We focus here on district mathematics specialists' adaptations to the TLP sessions and their associated rationales. We examined these adaptations using a modified version of Leufer and colleagues' (2019) framework for facilitators' adaptations of PD curriculum materials.

### ***Structural and Thematic Adaptations***

Adaptations can be structural or thematic. Structural adaptations are what Leufer et al. (2019) refer to as “materialized adaptations” made to the materials used in a PD program. We broaden this definition to include adaptations to the activities, structures, and routines in a PD program. Thematic adaptations involve changes to the theme or topical focus of an activity.

To illustrate, consider the adaptations that may be made to the core PSC activity modeled in the second and third TLP sessions in a cycle: the VBD. In a VBD, facilitators typically ask participants to keep a focal question in mind when viewing the video-clip a second time (Borko et al., 2015). Foregoing use of a focal question would be a structural adaptation; posing one consistent with a particular goal, interest, or priority would be a thematic adaptation.

### ***A Typology of Structural Adaptations***

Facilitators of a PD program can make several types of structural adaptations, including the following: a) follow, b) sort, c) modify, d) create, and e) omit (Leufer et al., 2019). These adaptations can be thought of as existing along a continuum from least to most change. While not necessarily an adaptation, the “follow” adaptation occurs when facilitators enact an activity or component of an activity as originally described or modeled. The “sort” adaptation occurs when activities are done in a different order than that originally described or modeled. The “modify” adaptation occurs when facilitators make a change to an activity or component of the activity, though the activity still resembles what was originally described or modeled. “Create” adaptations occur when a new activity or component of an activity is developed and introduced. Finally, “omit” adaptations occur when an entire activity or component is eliminated.

### ***Grain Size of Structural Adaptations***

Structural adaptations can occur at different grain sizes. With curriculum materials, for example, adaptations can be made to courses, thematic blocks, or single activities (Leufer et al., 2019). In the Problem-Solving Cycle, TLP sessions and PSC workshops are of the coarsest grain size. These consist of finer grained core activities, which themselves consist of finer grained structures and routines. Hence, modifications to TLP sessions could occur at a range of grain sizes. While omitting an entire session would be a large grain size adaptation, foregoing the routine of showing a video once without a focal question in mind would be finer grained.

### ***Effects of Adaptations***

There are affordances and limitations to adapting a PD program. Adaptations may signal that those making the adaptations are taking increasing ownership over a program, which prior research suggests is crucial to a program’s sustainability (Coburn, 2003). However, adaptations may result in activities, structures, and routines known to be supportive of teachers’ learning being lost. The core PSC activities are backed by research showing that grounding teachers’ conversations in artifacts of practice, such as student work samples or classroom video, supports growth in teachers’ knowledge and practice (Ball & Cohen, 1999; Sztajn et al., 2017). Hence, while modifying or omitting such activities might foster greater ownership, this could also diminish the impact of the program on teachers, and ultimately, students (Mumme et al., 2010).

The situation is different for thematic adaptations. As noted above, facilitators of the TLP program are encouraged to make adaptations to address their goals, interests, and priorities. We thus expected district mathematics specialists to modify core activities by adapting their thematic focus.

### ***Rationales Underlying Adaptations***

Like others, we conceive of adaptations “not as a threat to implementation fidelity, but a desirable and necessary professional practice through which facilitators’ pedagogical design capacity can unfold” (Leufer et al., 2019, p. 6). While encouraged by many program designers, little research has examined the adaptations made to PD programs or the rationales underlying them (Koellner & Jacobs, 2015). Studies of teachers’ adaptations of curricula suggest that these are rooted in a desire to address local goals, interests, and priorities (Davis et al., 2011; Nicol & Crespo, 2006). Leufer et al. (2019) found similar results in studying facilitators’ adaptations to materials for PD courses on language-responsive mathematics teaching. As examples, they found that facilitators’ adaptations were informed by what they

perceived to be teachers' learning needs, a desire to keep teachers' learning connected to classroom practice, and a concern with overloading teachers with theoretical knowledge. We add to this literature by examining district mathematics specialists' rationales for adapting a program for preparing mathematics teacher leaders.

## **Materials and Methods**

### **Researcher Positionality**

The first, second, and third authors are a white male, white female, and white female having seven, seven, and four years of experience teaching mathematics, respectively. The first author facilitated TLP sessions in year 1 of the project. The third author was one of the designers of the PSC and TLP programs. Although we each had expectations about what TLP sessions might entail, we sought to employ a descriptive, rather than evaluative, stance in our analysis.

### **Setting and Participants**

This study took place in a large, metropolitan school district serving students with diverse racial, linguistic, and cultural identities. In addition to the PD described here, the district hosted two full days of PD for all middle school mathematics teachers, in which teachers solved tasks from the district curriculum and planned lessons with grade-level partners. Teachers were also provided a mathematics teaching toolkit that offered suggestions for facilitating whole-class discussions, supporting effective groupwork, and giving students opportunities to struggle productively.

The primary participants in this study were nine district mathematics specialists based at a central office. Their titles included mathematics coach, mathematics content specialist, and program manager. Each had several responsibilities in addition to facilitating TLP sessions. The three coaches offered coaching to middle school teachers. The five content specialists supported implementation of the district's mathematics curriculum and facilitated PD for teachers. The program manager ensured that mathematics PD initiatives across the district were coherent and also oversaw the district's implementation of the Common Core State Standards for Mathematics (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). All district mathematics specialists were experienced mathematics teachers. While the program manager had much experience facilitating PD, the others had less. Collectively, we refer to the coaches, content specialists, and program manager as "district mathematics specialists" or DMSs. Our exclusive focus here is on their role in the TLP program preparing teacher leaders to facilitate PD.

A program supervisor, who was keenly aware of the district's vision for the teaching and learning of mathematics, and was thus likely to have insights to share regarding how the TLP sessions might have been adapted to align with this vision, was a secondary participant.

Three researchers were also involved in the project. In year 1, the researchers, with support from one DMS, facilitated the TLP sessions, modeling the facilitation of core PSC activities for teacher leaders and the DMSs who would later facilitate the TLP sessions. DMSs assumed increasing responsibility for planning and facilitating TLP sessions in year 2, receiving some support from a researcher; they assumed full responsibility in years 3 and 4.

The study also involved two or three teacher leaders from each of seven middle schools. Teacher leaders were middle school mathematics teachers with 1-20+ years of teaching experience. All were new to the role of teacher leader and either volunteered to be teacher leaders or were nominated by school administrators. They were not the focus of our analysis.

### **Data Collection**

We examined data collected over four academic years: 2016-2017, 2017-2018, 2018-2019, and 2019-2020. The data we examined in answering research question 1 consisted of: 1) video-recordings of all 23 TLP sessions, 2) field notes taken during each session, 3) content logs completed after each session, and 4) slide-decks created by the facilitators of the TLP sessions.<sup>1</sup> Field notes were taken by one member of our research team and covered the following: a) brief description of each activity in the TLP, b) duration of each activity, c) a lengthier summary of each activity, d)

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<sup>1</sup> TLP 2-3 in year 4 was canceled due to COVID. Video-recordings were ~7 hours long except for TLP 1-3 and 2-3 in year 3, which were ~2 hours long. We examined field notes, content logs, and slide-decks for all TLP sessions.

important moments or insights, and e) research or technical issues encountered. Content logs were created by one research team member and consisted of detailed written descriptions of each TLP session that covered: a) name of activity, primary facilitator(s), and participation structures used, b) resources used, and c) start and end time of the activity. In year 1, slide-decks were created by the researchers and DMS who facilitated the TLP sessions, while these were created by DMSs in years 2-4.

Additionally, we conducted hour-long, semi-structured interviews with each DMS involved in planning and facilitating TLP sessions. DMSs were interviewed up to two times per year. We also interviewed the program supervisor once. DMSs were asked about their experiences facilitating TLP sessions (e.g., “What do you see as the key changes you and your team have made to the TLPs this year?”). The program supervisor was asked about the PSC project overall and its connection to district goals (e.g., “What do you see as the roles of the TLP and PSC in the district in the upcoming year and moving forward?”). Interviews were audio-recorded then transcribed. To answer research question 2, we examined interview transcripts.

### **Data Analysis**

To identify the adaptations DMSs made to the TLP sessions, we first created three tables: one describing the core activities, routines, and structures in the first TLP in each cycle (i.e., TLP 1-1 and 2-1) in all four years; a second describing the same things for the second TLP in each cycle (i.e., TLP 1-2 and 2-2); and a third for the third TLP in each cycle (i.e., TLP 1-3 and 2-3). To create these tables, we examined field notes from the TLP sessions and content logs created after the sessions, as well as slide-decks from the TLP sessions, where available.

For each core activity, we noted whether or not particular structures and routines comprising the activity were followed. We also created a list of any new activities DMSs created that were not done in year 1. Following a similar procedure to Leufer et al. (2019), the first author compared DMSs’ enactment of each core activity to what was done in the corresponding activity in year 1. After making these comparisons, all three authors met to conduct peer audits, in which the first author’s coding was examined and disagreements were discussed and resolved (Creswell, 1998; Lincoln & Guba, 1985).<sup>2</sup> In these discussions, we decided that, if any routine or structure comprising an activity had been “modified” or “omitted,” the core activity itself had been modified. Conversely, if each routine and structure had been “followed,” the core activity had been followed. If the activity was not done, it had been “omitted.” We followed a similar sequence in coding thematic adaptations, with the first author coding these before then sharing his decisions with the second author, at which point, disagreements were discussed until consensus was reached. We agreed that, if DMSs posed a different focal question than that posed by researchers in the corresponding activity in year 1, a thematic adaptation had been made. After applying codes, the first and second authors wrote and examined analytic memos describing patterns in the coded data (Maxwell, 2013). In doing so, they identified patterns regarding the extent to which DMSs followed, modified, or omitted core activities, made thematic adaptations, and created new activities. We describe these patterns below.

To identify the rationales underlying adaptations, the first author read transcripts of interviews with four DMSs: two coaches, one mathematics content specialist, and the program manager. These DMSs were part of the project for all four years and played the greatest role in planning and facilitating TLP sessions; they were thus likely to be knowledgeable of adaptations that had been made. Only interviews from later years of the project, after DMSs had begun adapting the TLP program, were analyzed. The first author identified turns of talk in which DMSs discussed an adaptation and provided an underlying rationale. Turns in which an adaptation was discussed, but no rationale was provided, were excluded. The first and second authors then read these turns of talk and developed open codes to describe the types of rationales provided (Emerson et al., 1995; Saldaña, 2011). Once all rationales appeared to be captured by the codes, we independently coded subsamples of turns of talk comprised of ~18% of the full set. We then met to discuss and resolve disagreements, revising descriptions of codes to clarify their meaning. After two rounds, codes appeared stable. Next, we independently coded every remaining turn of talk with the final codebook, then met to discuss and resolve disagreements. The first author also re-coded turns from the subsamples coded using earlier codebooks; he also coded the interview with the program supervisor. Next, we wrote and examined analytic memos describing patterns in the coded data for DMSs’ rationales (Maxwell, 2013). Lastly, we identified quotes where rationales were provided for the adaptations we had identified in our analysis for research question 1.

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<sup>2</sup> For example, the first author thought the teacher analysis task required an examination of student work, but the third author said it could involve examination of multiple strategies and representations. We settled on the latter.

## Findings

We first provide an overview of the extent to which district mathematics specialists made structural and thematic adaptations to core activities in TLP sessions, as well as an overview of the rationales they provided for adapting the sessions as they did. We then provide a detailed description of how DMSs followed, modified, and omitted each core activity and made thematic adaptations to them, also presenting the rationales underlying each adaptation, where possible; we organize these findings by core activity. We end by describing new activities DMSs created.

### **Overview of Findings**

Overall, DMSs continued to model the facilitation of core PSC activities in TLP sessions (Tables 1, 2, and 3). Only two core PSC activities, the VBDs in TLPs 1-3 and 2-3 during year 3, were omitted over the four years of the project. However, as we describe below, DMSs modified the thematic focus of the activities and created several new ones to address district goals, interests, and priorities. Moreover, while the core activity of Debriefing the Facilitation was enacted after approximately half the VBDs, it was often omitted after Doing the Math.

[Insert Tables 1, 2, and 3]

In providing rationales for their adaptations, DMSs most often described why they continued to model the facilitation of core PSC activities, noting how these activities added structure to teachers' discussions during PD and ensured these discussions focused on teaching and learning, rather than logistical issues (Table 4). DMSs also often discussed how they modified the thematic focus of core PSC activities to address one particular aspect of teachers' practice they wanted to support: closing lessons. Lastly, in discussing activities they created, DMSs often referenced how they had created an activity to support teacher leaders in seeing the importance of tailoring what was modeled in TLP sessions to suit their unique school contexts.

[Insert Table 4]

### **Adaptations to Core Activities**

In describing adaptations to each core activity, we first describe what was modeled by researchers in facilitating the activity in year 1. We begin with the activity of Doing the Math.

#### ***Adaptations to Doing the Math***

Researchers modeled the facilitation of Doing the Math in TLP 1-1 and 2-1 in year 1. In TLP 1-1, they asked teacher leaders to solve a task from the district curriculum, then shared student solutions to the task they had created, asking teacher leaders to identify what students did and seemed to understand. In TLP 2-1, they asked teacher leaders to solve another district task. They then shared representations they had created for solving the task, asking teacher leaders to consider their affordances and limitations. The routines of analyzing student solutions and discussing affordances/limitations of representations were examples of the teacher analysis task.

DMSs modeled the facilitation of the core PSC activity of Doing the Math in every TLP 1-1 and 2-1 (Table 1). In sharing why they continued facilitating core PSC activities in general, DMS 4 spoke of how these activities force teachers' discussions during PD to focus on teaching and learning: "What I particularly like around the way [the PSC] is structured is that it, by design, forces teachers to talk about teaching and learning."<sup>3</sup> DMS 6 implied that they continued to model the facilitation of Doing the Math as the activity was consistent with the district's practice of having teachers do mathematics together: "PSC really mirrored what we do here. What we value here in our department. That is Doing the Math together and knowing the math deeply."

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<sup>3</sup> Quotes have been lightly edited for readability. Phrases that were repeated and certain words (e.g., like, um) were removed. Numbers (e.g., DMS 4) reflect the order in which district mathematics specialists began to facilitate TLP sessions.



In terms of modifications, DMSs used a task from outside the district curriculum when Doing the Math in TLP 2-1 in year 4 (Table 1). They also modified the thematic focus of the activity, asking teacher leaders to respond to the following question regarding the focal task: “What might students learn or take away from this lesson, and how is it represented in closure?” In explaining why they made “closure” a focus, DMS 5 noted that classroom observations led them to believe that teachers could benefit from support with the practice of closing lessons.

The other big thing is the idea of closure, summarizing a lesson. We decided that, at the very beginning, the Summer before the year started, we decided that closure was not being done in most of our classrooms. They were having wonderful conversations, and some not so wonderful, but they were having good conversations, and then just leaving it at that. They weren’t closing the lesson. They weren’t solidifying the mathematics.

The DMSs also modified the activity of Doing the Math in TLP 1-1 in years 2 and 3 by omitting the teacher analysis task (Table 1). No rationale was provided for this adaptation.

### ***Adaptations to Video-Based Discussions***

Researchers, with support from DMS 1, modeled this core activity in TLP 1-2, 1-3, 2-2, and 2-3 in year 1. They also enacted several routines. First, they asked teacher leaders to solve the focal task they would observe students solving, or the teacher launching, in the ensuing video-clip. They then asked teacher leaders to view the clip once with no focus in order to become familiar with its contents. Next, they asked teacher leaders to view the clip a second time with a particular focal question in mind. In TLP 1-2, the focus was on students’ mathematical thinking, while in TLP 1-3, it was on student authority. In TLP 2-2, the focus was on the mathematical practice of modeling; in TLP 2-3, it was on the teacher’s launch of the task.

DMSs continued to model the facilitation of the VBD for teacher leaders in all but two TLP sessions (Tables 2 and 3). As with the activity of Doing the Math, DMSs spoke of how VBDs offer structure that ensures teachers’ discussions during PD focus on, and support, teaching and learning. Consider the following quote from the program supervisor:

Without a structure ... very often, even if departments have time set aside, [meetings] can be taken up by lower level tasks like, “what are we going to put on the final exam?” That they’re looking at and listening to students’ thinking [on video], I think it is a kind of collaboration that will push and deepen their mathematical experiences, their understanding of students, and hopefully, therefore, their students’ mathematical work.

DMSs modified the structure of the VBD in several ways. For instance, in TLP 1-2 and 2-2 in year 3, rather than show the video-clip once without a focal question, they asked teacher leaders to have a different focal question in mind both times they watched the clip. Another notable modification to the structure of VBDs, which several DMSs spoke of in their interviews, involved the incorporation of an additional data source. During the VBD in TLP 1-2 in year 3, DMSs first showed a video of a group of four students solving a mathematics task. After teacher leaders shared their observations of the clip in a whole-group discussion, DMSs presented them with the students’ responses to a brief “practical measures” survey (Jackson et al., 2016), which asked the students several questions about their experiences discussing mathematics with their tablemates in the preceding lesson. The survey data was brought in as it presented information about one student in the video that contradicted what the video seemed to portray. As the following quote from DMS 2 illustrates, DMSs thought showing the video, then sharing the survey data, would challenge assumptions teacher leaders might have made about this student based on the video.

[DMS 6] got video in a former teacher leader’s classroom and also had the practical measures data ... [W]e took a piece of video and had teachers writing down their first impressions about what was going on in the video. The video made it look like the girl was not participating at all. Then, we took the practical measures data from the class and [showed the] responses [of the four students in the video]. Through that data, found out the girl was actually really high status in math and her responses to the practical measures was that she knew all of this already. That challenged our perceptions of what was going on with the video. And so that was interesting learning for everybody to see two pieces of data to make a more complete story about what was going on in that moment, I think.

This modification foregrounded a previously unexamined theme (i.e., challenging assumptions) and used a new structure (i.e., survey data). We thus view it as both thematic and structural.

DMSs omitted the core activity of modeling a VBD in TLP 1-3 and 2-3 in year 3. This occurred because they shortened these TLPs to be 2-hour, after-school sessions, which left little time to model the facilitation of a VBD. The sessions were shortened, in part, because teacher leaders had shared that they were missing too much teaching time for district PD. As DMS 2 explained when describing a conversation she had had with a teacher leader:

[S]he was like, “Well, you know, I’m not sure if that’s for me. Too many days out of the classroom.” That’s the thing that a lot of teacher leaders think about, is that it gets too many days out of the classroom when, even though this year, we tried to adapt for that by having a two-hour, after school [TLP session] for the third cycle. That didn’t work. I don’t think that worked well in terms of the cycle. I think, in general, there’s so [much] PD that’s happening in the district that teachers are feeling the pressure.

These sessions were also shifted after-school as DMSs believed this would allow teacher leaders from a different teacher leadership initiative to take part, thus providing an opportunity for teacher leaders from multiple initiatives to learn together. However, as DMS 6 noted:

We tried to combine it with [another teacher leadership initiative] and it didn’t really work ... all the Problem-Solving Cycle people showed up, I don’t think they got, everybody left, and they didn’t know what they were supposed to do. That was a mistake.

### ***Adaptations to Debriefing the Facilitation***

In year 1, researchers modeled the core activity of Debriefing the Facilitation for DMSs in each TLP session, although what was modeled differed depending on whether the activity being debriefed was Doing the Math or a VBD. After Doing the Math, researchers shared several decisions they had made in planning the activity (e.g., how they created invented student work samples), before then fielding questions from the teacher leaders. After VBDs, on the other hand, another researcher came to the front of the room and asked teacher leaders to put on their “facilitator hat.” The researcher then posed several questions to the researchers and DMS who facilitated the VBD about both their planning and the decisions they made while facilitating the activity. The floor was then opened for teacher leaders and DMSs in the room to pose questions.

Though often omitted after Doing the Math (Table 1), DMSs debriefed after facilitating most VBDs (Tables 2 and 3). While they did not often share their reasons for continuing to follow this core practice, DMS 2 did speak of the value of Debriefing the Facilitation after VBDs, noting that this made their many decisions “really explicit and clear” for teacher leaders.

The most useful, I think, would be the layering of hats and debriefing explicitly after each session, the purpose and the reason why for each piece of the TLP. It really gave a specific, a really specific realm into where the thinking was. Thinking about the various layers of thinking that go into all the instruction, so the learning hat and the teacher hat and then the most helpful was thinking about the teacher leader hat, where debriefing the Video-Based Discussion and all the choices of facilitation became really explicit and clear, as well as listening to the questions that the [teacher leaders] would ask.

### **Activities Created by District Mathematics Specialists**

We close by describing activities DMSs created. In year 1, researchers modeled the creation of new activities. For example, in TLP 1-2, they created an activity in which they asked teacher leaders to consider the notion of “authority” and to examine definitions of the term before modeling a VBD focused on authority.

Perhaps unsurprisingly, then, in years 2-4, DMSs also created several new activities. These activities allowed them to address district goals, interests, and priorities. For instance, DMSs created an activity asking teacher leaders to list features of an effective lesson closure – a district priority. They then used this list to create a “closure tool” that teacher leaders examined in a subsequent activity. DMSs did not speak of these specific activities in their interviews.

In the majority of the TLP sessions they facilitated, DMSs also began with a “connector” activity that they created. As they shared with us, these activities were designed to engage teacher leaders and orient them towards a focal idea for the session. For example, DMSs created an activity in which they asked teacher leaders to build paper airplanes, test them out and gather data about test flights, then use that data to inform modifications to the design of the planes.

As one DMS explained, the purpose of this activity was to support teacher leaders in seeing the importance of gathering data about their schools, then referencing that data in modifying their PSC workshops to suit their unique school context. This same DMS described elsewhere how the teacher leaders at one school had led a VBD in a previous PSC workshop that was almost identical to the VBD modeled in the preceding TLP session. In her view, this VBD was “awkward” for teachers, as the teacher leaders had not modified it to align with their school’s context. DMS 4 shared the following in saying why the paper airplane activity was created:

[DMS 2] really tied that into design-thinking for your school sites and your math departments. I remember, when it was planning time, she was really trying to connect that to, “You have to think about your context.” Right? “The changes that you make [to your PSC workshops are] dependent on your context.” We’ve been trying to get at this thing around ownership of the process. Right? Right? I feel like that’s still our biggest thing with PSC is, “how do they own it?” So, there’s not compliance.

In sum, DMSs made few structural adaptations to the TLPs and continued to model the facilitation of core PSC activities. However, they modified the thematic focus of these activities and created new ones to address district goals, interests, and priorities. These adaptations were informed by DMSs’ knowledge of what was occurring in district schools and classrooms.

### Discussion

This article describes how and why district mathematics specialists adapted a teacher leadership preparation program. As the program was designed to be adaptive (Borko et al., 2015), we expected DMSs to modify it through a combination of structural and thematic adaptations (Koellner & Jacobs, 2015; Leufer et al., 2019). As expected, DMSs did adapt TLP sessions, doing so primarily through various thematic adaptations and keeping the overall structure of the TLP largely intact. DMSs consistently modeled the facilitation of the core PSC activities of Doing the Math and VBDs, however, they modified the thematic focus of these activities to address district goals, interests, and priorities (e.g., the practice of closing a lesson). This approach suggests that the DMSs saw the TLP program and core PSC activities as vehicles through which they could address their unique goals, interests, and priorities.

In our view, this approach is welcomed, as it suggests that teacher leaders continued to participate in core activities during TLPs shown to be supportive of teacher learning (Elliott et al., 2009; Jacobs et al., 2014; Koellner & Jacobs, 2015; van Es & Sherin, 2010). It also suggests that teacher leaders may have gone on to facilitate core PSC activities in their workshops. While not examined here, in prior work, we found that when core PSC activities are modeled in TLPs, teacher leaders go on to facilitate these in their site-based PSC workshops (Borko et al., 2021).

In modifying the thematic focus of core PSC activities during TLP sessions, DMSs took increasing ownership over the program – key to the sustainability of any PD initiative (Coburn, 2003). Modifying the thematic focus of activities to address aspects of practice that district teachers were working on may also have made the TLP sessions and ensuing PSC workshops of greater relevance to teachers, potentially contributing to enhanced buy-in to the PD initiative.

DMSs also continued Debriefing the Facilitation of the VBDs. As prior research has shown the merits of debriefing for the learning of both teachers and teacher leaders (Lesseig et al., 2017; Munson et al., 2021), it is possible that continuing this practice may have enhanced teacher leaders’ emerging facilitation skills. While no rationale was shared for rarely debriefing after Doing the Math, this may have occurred because DMSs regarded this activity as likely to be more familiar to the teacher leaders, and thus one they did not need to debrief as often.

Although DMSs maintained the overall structure of the program, they made some substantive omissions. In particular, they shortened TLP 1-3 and 2-3 in year 3, leaving no time to model the facilitation of the core PSC activity typically modeled in that session, the VBD, or for teacher leaders to plan their site-based PSC workshops. Crucially, DMSs recognized that this adaptation was problematic, noting that teacher leaders left these TLP sessions unsure what to do in their ensuing PSC workshops. This recognition seemed to result from DMSs’ understanding of the TLP and PSC programs, specifically, that TLP sessions, and the modeling of core activities, are essential to preparing teacher leaders to facilitate effective site-based workshops.

DMSs' adaptations were rooted in their knowledge of what was occurring in district schools and classrooms. For instance, the decision to create a "connector" activity urging teacher leaders to adapt the core PSC activities modeled at TLP sessions to suit their school context was informed by DMSs' observations of PSC workshops. Similarly, the decision to focus on lesson closures was rooted in knowledge of what was occurring in district classrooms. Although support for such adaptations can be found in the literature (e.g., Hiebert & Grouws, 2007; Stein et al., 2008), DMSs seemed to draw upon their "knowledge-in-practice" rather than research-based "knowledge-for-practice" (Cochran-Smith & Lytle, 1999) in making these adaptations.

Finally, this study demonstrates that Leufer et al.'s (2019) framework for structural adaptations can be used to analyze adaptations to a program of facilitator PD. Leufer et al. developed their framework by "lifting" (Prediger et al., 2019) it from research on teachers' adaptations of curriculum materials and applying it to the study of facilitators' adaptations of PD curriculum materials. Similarly, we lifted Leufer et al.'s framework of structural adaptations and used it successfully to analyze DMSs' adaptations to a program of facilitator PD.

### **Implications, Limitations, and Future Directions**

The way DMSs adapted the TLPs – maintaining core activities while modifying their thematic focus to address district goals, interests, and priorities – enabled them to ensure the program's relevance and enhance the likelihood of it continuing beyond the end of the research project (Coburn, 2003). Designers of other adaptive PD programs may thus find it fruitful to encourage PD leaders to maintain core program activities while modifying their thematic focus.

This study demonstrates that DMSs require a rich understanding of adaptive PD programs if they are to recognize certain adaptations as problematic. Importantly, DMSs here recognized that shortening TLP sessions was troublesome, as this left teacher leaders unsure what to do in their PSC workshops. This recognition was based on DMSs' understanding that TLP sessions serve a key role in preparing teacher leaders to offer high-quality professional development for their colleagues. Absent this understanding, DMSs might not have recognized such adaptations as problematic. This suggests that researchers may need to support DMSs to develop not only the capacity to plan and facilitate core program activities, but also an understanding of the various components of a PD initiative and their inter-relations.

It is important for researchers to support DMSs in considering research knowledge (i.e., "knowledge-for-practice") in addition to experiential knowledge (i.e., "knowledge-in-practice") when adapting a PD program (Cochran-Smith & Lytle, 1999). DMSs made thematic adaptations to focus on practices that research suggests are important for student learning (e.g., lesson closure) (Hiebert & Grouws, 2007; Stein et al., 2008). At times, however, this alignment seemed somewhat fortuitous. This suggests that researchers may play a role in ensuring DMSs have access to and perhaps consider research knowledge in addition to experiential knowledge when adapting PD initiatives.

Our analysis was bounded by a focus on DMSs' adaptations to TLP sessions. We did not examine how such adaptations influenced teacher leaders' ensuing PSC workshops. We imagine that not modeling a VBD in the shortened TLP sessions may have resulted in few VBDs taking place in teacher leaders' subsequent PSC workshops, but we did not examine this. In a separate study, we found evidence that what gets modeled at TLP sessions is often then facilitated in PSC workshops (Borko et al., 2021). More research is needed, however, to examine the extent to which adaptations to TLP sessions impact PSC workshops. Future research could also employ methods like those described here to examine how, and why, teacher leaders adapt the core activities modeled at TLP sessions. Such work could also study the effects of teacher leaders' adaptations on their colleagues' learning in PSC workshops, and ultimately, students' learning.

### **Acknowledgments**

This work was supported by the National Science Foundation under Grant No DRL-1417261. Any opinions, findings, and conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the NSF. This study was granted ethics approval by the Stanford University Institutional Review Board under protocol number 31369. All study participants consented to participate in this study by reading then signing a consent form shared with them by a member of our research team. The authors would like to thank the district mathematics specialists who so generously shared and described their facilitation practice with us for this study. We would also like to thank the anonymous reviewers and editors for their thoughtful feedback on earlier versions of this manuscript.

### Declaration of Interest Statement

We have no known conflict of interest to disclose.

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**Table 1**

*Adaptations to TLP 1-1 and TLP 2-1 in Years 2, 3, and 4*

	TLP 1-1				TLP 2-1			
	Year 1 (Baseline)	Year 2	Year 3	Year 4	Year 1 (Baseline)	Year 2	Year 3	Year 4
<b>Doing the Math</b>								
Solve the task together	Yes	Yes - Modify	Yes - Modify	Yes - Follow	Yes	Yes - Follow	Yes - Follow	Yes - Modify
Teacher analysis task	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of tasks	1	No	No	Yes	1	1	1	Yes
	6 <sup>th</sup> -grade Magic 3/4	3	3	6 <sup>th</sup> -grade Nana's Paint Mix-Up	6 <sup>th</sup> -grade Nana's Chocolate Milk	8 <sup>th</sup> -grade Volume of a Sphere	7 <sup>th</sup> -grade Sugar, Sugar	N/A
Focal question(s)	Yes (4) <sup>a</sup>	No	Yes (2)	Yes (2)	Yes (1)	Yes (1)	Yes (1)	Yes (2)
Grade-level or mixed-grade groups	Mixed-grade	Grade-level	Grade-level	Mixed-grade	Mixed-grade	Mixed-grade	Mixed-grade	Mixed-grade
<b>Debrief the Facilitation</b>	Yes	Yes - Modify	No - Omit	No - Omit	Yes	Yes - Follow	No - Omit	No - Omit
Switching roles from Teacher to TL	Yes	Yes	NA	NA	Yes	Yes	NA	NA
Questions were posed of facilitator	Yes	No			Yes	Yes		
Debriefed the planning and/or facilitation	Yes	No			Yes	Yes		

<sup>a</sup> Numbers in parentheses show the number of focal questions that were used.

Note. 

Follow	Modify	Omit
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**Table 2**

*Adaptations to TLP 1-2 and TLP 2-2 in Years 2, 3, and 4*

	TLP 1-2				TLP 2-2			
	Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4
<b>Video-Based Discussion</b>	Yes	Yes - Follow	Yes - Modify	Yes - Follow	Yes	Yes - Follow	Yes - Modify	Yes - Modify
Solve the focal task first	Yes	Yes	No	Yes	Yes	Yes	Yes	No
Number of views	2	2	2	2	2	2	2	2
First watch with no focus	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Focal questions	Yes (2) <sup>a</sup>	Yes (2)	Yes (2)	Yes (2)	Yes (1)	Yes (1)	Yes (2)	Yes (1)
Second watch with focus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Debrief the Facilitation</b>	Yes	No - Omit	Yes - Follow	No - Omit	Yes	Yes - Follow	Yes - Follow	No - Omit
Switching roles from Teacher to TL	Yes	NA	Yes	NA	Yes	Yes	Yes	NA
Debriefed posed questions of facilitator	Yes		Yes		Yes	Yes	Yes	
TLs posed questions of facilitator	Yes		Yes		Yes	Yes	Yes	
Debriefed the planning	Yes		Yes		Yes	Yes	Yes	
Debriefed the facilitation	Yes		Yes		Yes	Yes	Yes	

<sup>a</sup> Numbers in parentheses show the number of focal questions that were used.

Note. 

Follow	Modify	Omit
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**Table 3**

*Adaptations to TLP 1-3 and TLP 2-3 in Years 2, 3, and 4*

	TLP 1-3				TLP 2-3			
	Year 1 (Baseline)	Year 2	Year 3	Year 4	Year 1 (Baseline)	Year 2	Year 3	Year 4
<b>Video-Based Discussion</b>	Yes	Yes - Modify	No - Omit	Yes - Modify	Yes	Yes - Modify	No - Omit	Cancelled due to COVID-19
Solve the focal task first	Yes	No	NA	No	Yes	Yes	NA	
Number of views	2	2		2	2	2		
First watch with no focus	Yes	Yes		No	Yes	No		
Focal questions	Yes (1) <sup>a</sup>	Yes (1)		Yes (2)	Yes (1)	Yes (2)		
Second watch with focus	Yes	Yes		Yes	Yes	Yes		
<b>Debrief the Facilitation</b>	Yes	Yes - Follow	NA	No - Omit	Yes	Yes - Follow	NA	
Switching roles from Teacher to TL	Yes	Yes		NA	Yes	Yes		
Debriefed posed questions of facilitator	Yes	Yes			Yes	Yes		
TLs posed questions of facilitator	Yes	Yes			Yes	Yes		
Debriefed the planning	Yes	Yes			Yes	Yes		
Debriefed the facilitation	Yes	Yes			Yes	Yes		

<sup>a</sup> Numbers in parentheses show the number of focal questions that were used.

Note.

Follow	Modify	Omit
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**Table 4**

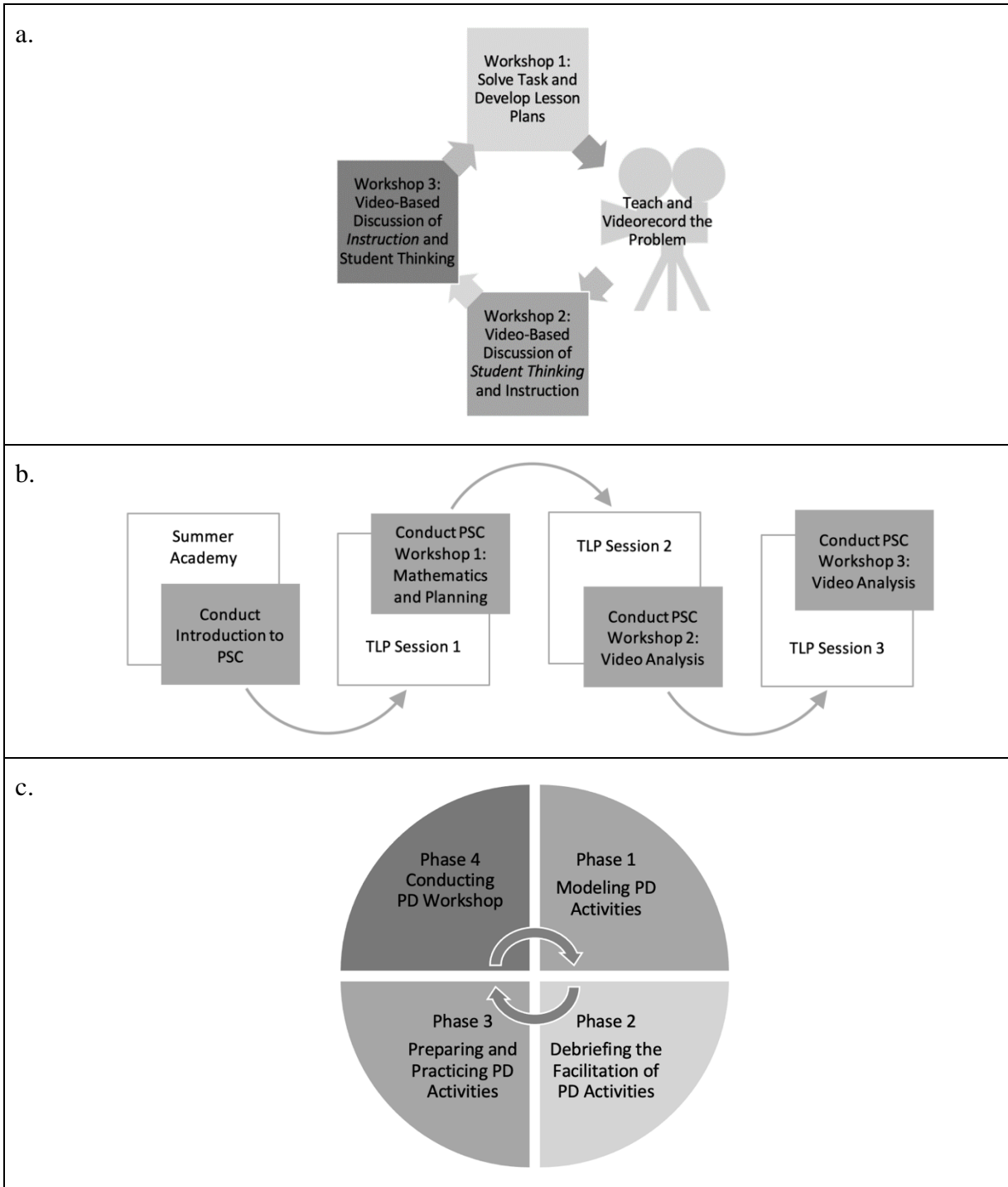
*Codes for the Rationales Underlying District Mathematics Specialists' Adaptations*

Adaptation		Rationale	Sub-totals	Totals
Follow	Follow program or activity because it...	Offers structure to support teacher learning	16	57
		Offers structure to support facilitator learning	13	
		Develops community	10	
		Is rooted in research	7	
		De-privatizes teachers' practice	5	
		Is consistent with district vision and practices	4	
		Yields data to triangulate with observational data	2	
Modify	Modify activity because doing so...	Addressed a perceived instructional need	10	27
		Challenged teachers' assumptions	7	
		Brought together teacher leaders from multiple initiatives	5	
		Allowed teachers to miss less teaching time	2	
		Created coherency in messages from multiple initiatives	2	
		Fostered curiosity	1	
Create	Create activity because it...	Urged teacher leaders to make workshops suit local context	6	16
		Aligned with interest in the PD having an overarching focus	5	
		Introduced teachers to research	4	
		Was okay to do a risky activity given the community's strength	1	

*Note.* There were 65 total turns of talk that we analyzed in the interviews. Totals here exceed that number, as a single turn could have been assigned more than one code. For example, in describing why they continued to model VBDs, one district mathematics specialist noted that the activity “offers structure to support teacher learning” and “de-privatizes teachers’ practice.”

**Figure 1**

*Problem Solving Cycle (a), Teacher Leader Preparation (b), and Learning to Lead (c) Models*



*Note.* The Learning to Lead model is adapted from McDonald, Kazemi, and Kavanagh (2013).