TRACING THE CO-EVOLUTION OF TEACHER LEARNING BETWEEN PROFESSIONAL DEVELOPMENT AND CLASSROOM PRACTICE

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How teachers can experience adaptive professional development (PD) experiences is still understudied in the literature on teacher learning, which for the most part reflects an emphasis on learning outcomes rather than the process of learning. In this study, we use a situated perspective on teacher learning to investigate the coevolution of a teacher's sensemaking about facilitating classroom discussions between her classroom practice and the school-based PD experiences. The study contributes to an understanding of how the process of teacher learning can be supported through continuous, adaptive professional learning experiences and of the co-evolution of teacher learning between settings of practice.

Keywords: Adaptive Professional Development, Teacher Learning, Classroom Discourse

Mathematics classroom discussions are characterized by social and intellectual demands, where teachers not only support students' knowledge and skills but also their identities as problem solvers. During these discussions students engage collaboratively in a process where they make claims and justify them using reasoning that is based in disciplinary practices and in their existing knowledge and cultural and linguistic resources. Facilitating this work is complex and often non-routine: it requires from teachers a capacity to improvise in the midst of contingent interactions, relying on professional judgment to steer instruction productively to support mathematical goals and an inclusive mathematics learning community. Mathematics teachers, for example, must make judgments about how to respond to students individually and in groups, drawing on specialized knowledge of both mathematics and student thinking to further instructional objectives. All the while, they must attune their practice to students' needs, treating students as sensemakers and providing all students access to cognitively demanding tasks. Learning to do this complex and responsive work of teaching requires models of professional learning that nurture teachers' adaptive expertise and pedagogical reasoning in relation to teachers' own contexts of practice. How teachers experience such adaptive professional learning experiences is still understudied in the literature on teacher learning, which for the most part reflects an emphasis on learning outcomes rather than the process of learning (Walkoe & Luna, 2019). In this study, we aim to investigate how a teacher's sensemaking about facilitating classroom discussions between her classroom practice and the school-based professional development (PD) co-evolve.

The extant literature on teacher learning emphasizes the importance of designing professional learning opportunities that are adaptive and responsive to teachers' local contexts and their sensemaking (Ghousseini & Kazemi, in press). Transformative teacher learning in mathematics can be supported through sustained, connected professional development experiences that are close to teachers' own practice where they have opportunities to make sense of new knowledge and instructional practice through ongoing collaboration and inquiry around purposive activities (Silver et al., 2009; Lefstein et al., 2020). Among the PD models aligned with this vision of teacher learning is job-embedded professional development where teachers are supported to make sense of the complexities of teaching during their workday or through experiences that are

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integrated in the contexts of their own practice (Kazemi et al., 2021; Zepeda, 2014). Typical approaches to job-embedded professional development include coaching and modeling of research-based instructional strategies, and co-teaching practices (Semon et al., 2020). Althauser (2015), for instance, describes a job-embedded PD that engaged teachers in aligning their curriculum with state math standards and in peer teaching where they implemented teaching strategies and assessments that they had developed with the support of their district's curriculum specialist. Most studies of job-embedded PD, however, focus on outcomes such as student learning or teacher practices and their views of such experiences (Althauser, 2015; Dennis & Hemmings, 2018). Missing from the literature are examinations of how teachers learn through job-embedded PD. Walkoe and Luna (2019) affirm the absence of such studies from the literature and argue, "Questions that address the process of teacher learning are largely absent in studies of teacher learning. These include important questions such as: What mechanisms contributed to observed outcomes? What resources did teachers bring to bear and how were they utilized in PD activities? What goals emerged for teachers as they engaged in PD?" (p. 285).

Our investigation of teacher learning in this paper is motivated by these questions. Using the case study of a teacher who participated in an adaptive, job-embedded PD focused on learning to facilitate classroom math discussions, we address this question: How did the teacher's sensemaking co-evolve between her classroom practice and the school-based PD experiences? By examining her process of recontextualization (van Oers, 1998) of goals and resources negotiated with other participants from the PD through her own practice, we aim to contribute to an understanding of teacher learning from PD opportunities closely tied to their practice. The study also contributes to the theme of this conference in the way our results bring insights related to the problems of practice teachers face in facilitating student-centered classroom mathematics discussions.

Teacher Sensemaking About Argumentation-Based Discussions as a Process of Recontextualization

The literature on argumentation repeatedly asserts that argumentation is more than an activity—it rests on establishing a classroom culture for argumentation over time through intentional norm setting, activity selection, and guidance (Knudsen et al. 2018). Like all ambitious teaching, developing a culture for mathematical argumentation is complex and creates many intellectual and pedagogical demands for teachers in the way they have to intentionally (1) choose and structure mathematical problems or routines; (2) develop norms for what counts as acceptable arguments; and (3) provide language supports and use discourse structures to engage students in the practices of argumentation (Makar et al., 2015).

We use a situative perspective on teacher learning (Greeno, 2005) to frame sensemaking about facilitating argumentation as a teacher's opportunities to wrestle with new ideas and figure out how and why they work within their own teaching and learning spaces. In the context of adaptive professional development that is embedded in teachers' practice, teacher sensemaking involves opportunities to attend to problems of practice through experimenting with and revisiting ideas, drawing in the process on a wide array of resources and tools to support emergent ideas or goals (Kazemi et al., 2021). Researchers have called for attending to the dynamic boundaries and relationships between various settings that influence and explain teacher learning, looking at the coevolution of participation between classroom practice and PD (Kazemi & Hubbard, 2008). In this study, we focus on this form of coevolution of participation through

the lens of continuous sensemaking and recontextualizing of learning (van Oers, 1998) across settings of teacher learning through adaptive PD.

The literature on teacher learning typically treats the idea of recontextualizing as teachers taking constructed discursive resources from one context and reconstructing them to enact in a secondary context that has unique conditions and rules (Ensor, 2001; Marchant et al., 2021). This view of context explains teachers' actions in terms of using knowledge, tools, and experience gained in one context and applying them to a new scenario. In contrast, Van Oers (1998) characterizes recontextualization as a process of continuous sensemaking in the way a context is treated as not a static setting that teachers are placed into, but rather dynamically constructed by them in situ as a particular activity setting. This is accomplished by determining one's goal, examining prior experiences, and "finding out which means are available, investigating which actions make sense to perform in order to achieve the goal chosen, and by relating motive, goal, object, means etc…" (van Oers, 1998, pp. 481-482). We posit that this continuous process of recontextualization provides teachers with opportunities to learn. Viewed from a social practice perspective, adaptive PD can enable a process of continual contextualizing when participants engage in mutual activities where they experiment with new possibilities for action and adjust their contributions to shared activities as they move between settings of learning over time.

Methods

Participants and Context

The professional development model, we refer to as Learning Labs (LLs), was embedded in an elementary school located in the United States' Midwest. The school is diverse with 40% Latinx students. The LLs were co-designed and co-facilitated by three instructional coaches from the school and three teacher educators from our research team. Our co-design work engaged and involved eight teacher participants in learning to facilitate argumentation-based mathematics discussions. Each LL consisted of four phases: new learning, planning, enactment, and debrief (Kazemi et al., 2021). In the new learning phase participants engaged in a reading, analysis of artifacts, or discussion of problems of practice related to the practices of giving explanations or justifications and supporting broad student participation. Building on their new learning, then the participants planned a lesson together to be enacted in one of the participant teachers' classes. During this planning, all participants shared ownership of designing the math task, crafting tasks and working on questions that elicited and pressed for students' thinking. The enactment phase involved inquiry into practice where teachers both did the work of teaching in response to students' performance and had opportunities to pause the lesson to consider problems of practice. In the debrief phase, the participants reflected on the lesson and areas of improvement and identified future collective goals for the labs and for their own practice. Between consecutive LLs, the teachers and coaches met weekly to co-design, implement, and reflect on lessons deliberately enacted by the teachers to contextualize some goals related to the PD in their own practice. They reflected on these lessons using video-stimulated recall interviews (VSRIs).

In this paper, we use an instrumental case study (Stake, 2005) of one teacher participant, Karla (pseudonym), to inform our understanding of a particular phenomenon, namely, how teachers' sensemaking about ambitious teaching can co-evolve between participation in PD experiences and their own classroom practice. Karla is a white female 5th grade teacher who was an active participant in the LLs, often highlighting her own experiences and vocalizing her sensemaking. Her propensity to reflect publicly on the way her sensemaking was coevolving between LLs and her own practice influenced our choice of her for this case study.

Data Collection and Analysis

For this paper, our data consisted of (1) transcripts of three interviews conducted with Karla (one prior to the start of the LLs and two at the end of each year); (2) Eight transcripts of LLs debriefing phases spanning over years 1 & 2; (3) Four audio records of video stimulated recall interviews (VSRIs) that Karla completed with her school-based coach. The VSRIs focused on classroom discussions that Karla recorded between LLs. Our data analysis at one level focused on identifying the problems of practice that Karla grappled with across contexts and the array of tools and resources she used over time to address them. We tracked these problems and resources longitudinally as suggested in Figure 1, across both her participation in LLs as well as in her interviews and VSRIs with the instructional coach.

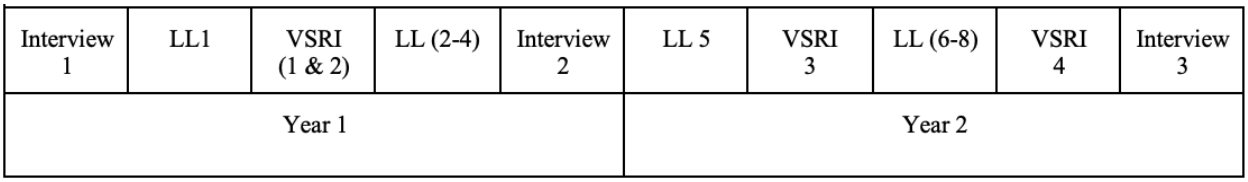

Figure 1: Karla's data sources over two years

We started with the first interview to determine Karla's initial practice with respect to leading mathematics discussions, and to identify the nature of questions and challenges she faced while promoting them in her classroom. We recognized a problem of practice when Karla reported on classroom interactions that she experienced as troublesome, challenging, confusing, recurrent, unexpectedly interesting, or otherwise worthy of comment" (Horn & Little, 2010, p. 189). This first analysis surfaced a central problem of practice for Karla related to *bringing more student participation and voices during whole class discussions*. A prior analysis of the problems of practice that participants jointly identified over the course of the LLs (Cordero-Siy et al., 2021) allowed us to trace the continuity of Karla's sensemaking about this problem of practice through her participation in the LLs. Starting with LL1, we identified instances where she contributed to the participants' joint work on framing challenges related to participation. We focused on moments where she elaborated the nature of a challenge and provided insights from her experience about how to address the challenge and the reasoning behind it. Focusing on her participation in LLs' debriefs was constructive to our understanding of her sensemaking as we saw alignment between Karla's challenge of broadening participation in her classroom discussions and the Lab participants' joint sensemaking. We also identified the materials and resources (such as practices or classroom tools) that participants proposed to address the problem of practice during their joint sensemaking. We continued using these analytic lenses across consecutive data sources spanning both LLs and Karla's classroom practice: we tracked the evolution over time of the way Karla reframed various challenges pertaining to the problem of practice she is addressing, and revisited her understanding or use of a resource or a tool to address the problem of practice she is focusing on. Figure 2 represents this co-evolution between LLs and her practice.

Results

Karla's initial practice with discussions. In her initial interview (Int.1), Karla described her classroom mathematics discussions as typically happening in small groups where students share different strategies and explain their thinking to each other. She reported avoiding whole class

discussions because she would "hear from the same five voices, so it's better when we're in small groups." This concern for "varied student voices" (Int. 1) was a problem of practice that persisted in Karla's thinking and sensemaking throughout her participation in the PD in Years 1-2. It was motivated by Karla's overarching commitment to creating a learning environment in which "all students identify as someone who can learn math" (Int. 1). Leveraging more student voices, however, was complicated by what Karla referred to as *student vulnerability in the face of power relationships in the classroom*. She stated, "some students see themselves as leaders and others as followers." Leaders, in her view, are ones perceived to give better explanations or to be more fluent in English. This situation influenced students' hesitation to participate in classroom discussions, especially in whole group.

Karla's continual commitment to attending to this problem of practice led her to recontextualize ideas, tools, and resources across these contexts. Reflecting on the consequences of these experiences with her coach and with other participants led her to a more nuanced understanding of the challenge of student participation that went beyond the binary of small group vs. whole group. For space limitations, we present this evolution in her thinking based on her participation in the first year of PD.

The co-evolution of Karla's sensemaking between LLs and her practice. A recurring theme in the LLs was creating classroom communities for all students to engage with mathematical ideas (Cordero-Siy et al., 2021). This theme aligned with Karla's challenge of leveraging more student voices, where we found evidence in Karla's VSRIs of her continual pursuit of creating spaces for students to share their own ideas and engage with each other's mathematical thinking. Accordingly, she drew from various pedagogical tools leveraged during LLs to support the pursuit of this goal. As represented in Figure 2 below, over the course of the LLs participants leveraged various pedagogical resources and tools to facilitate equitable participation. For example, in LLs 1 and 2 participants reflected on factors that may be shaping student willingness to talk—the physical setting of the classroom, the nature of the task, and students' familiarity with routines that support their sharing of ideas. Accordingly, they reasoned about possible resources and tools that could build on these factors constructively. Among the resources they considered were instructional tasks that focus on number relations rather than the right answer, using more turn-and-talk participation structure, and supporting student communication with visuals and tools like small whiteboards.

In our analysis of Karla's VSRIs with her coach, we noted the way she was drawing on these resources and problematizing their use at the same time. She revealed in her first VSRI the way the use of white boards and turn-and-talk to facilitate student sharing did not fully resolve the issue of inequitable participation as only a few students were willing to share their thinking. Karla pondered whether calling on students to paraphrase their partner's ideas could enhance the efficacy of these classroom routines and tools. Student sharing with the help of these resources, she opined, still faced the tension of putting students in a vulnerable position when 'cold-calling' students—in case they could not articulate or did not understand their partner's ideas. Moreover, while partner talk and work on a whiteboard may have supported student talk in small groups, Karla explained that inequitable participation persisted in the whole group setting. Students did not engage with others' solution strategies when shared with the whole class. This concern found resonance in the subsequent LL2 when participants noticed similar patterns of participation. During the debrief, Karla noted then "But that's something I struggle with in my class, and I wonder if it's pacing, the activity went too long. That [students] all had such rich partner to

partner conversations then when I ask someone to get up and explain it, it's like I already know this because I just talked about it with my partner." (LL2)

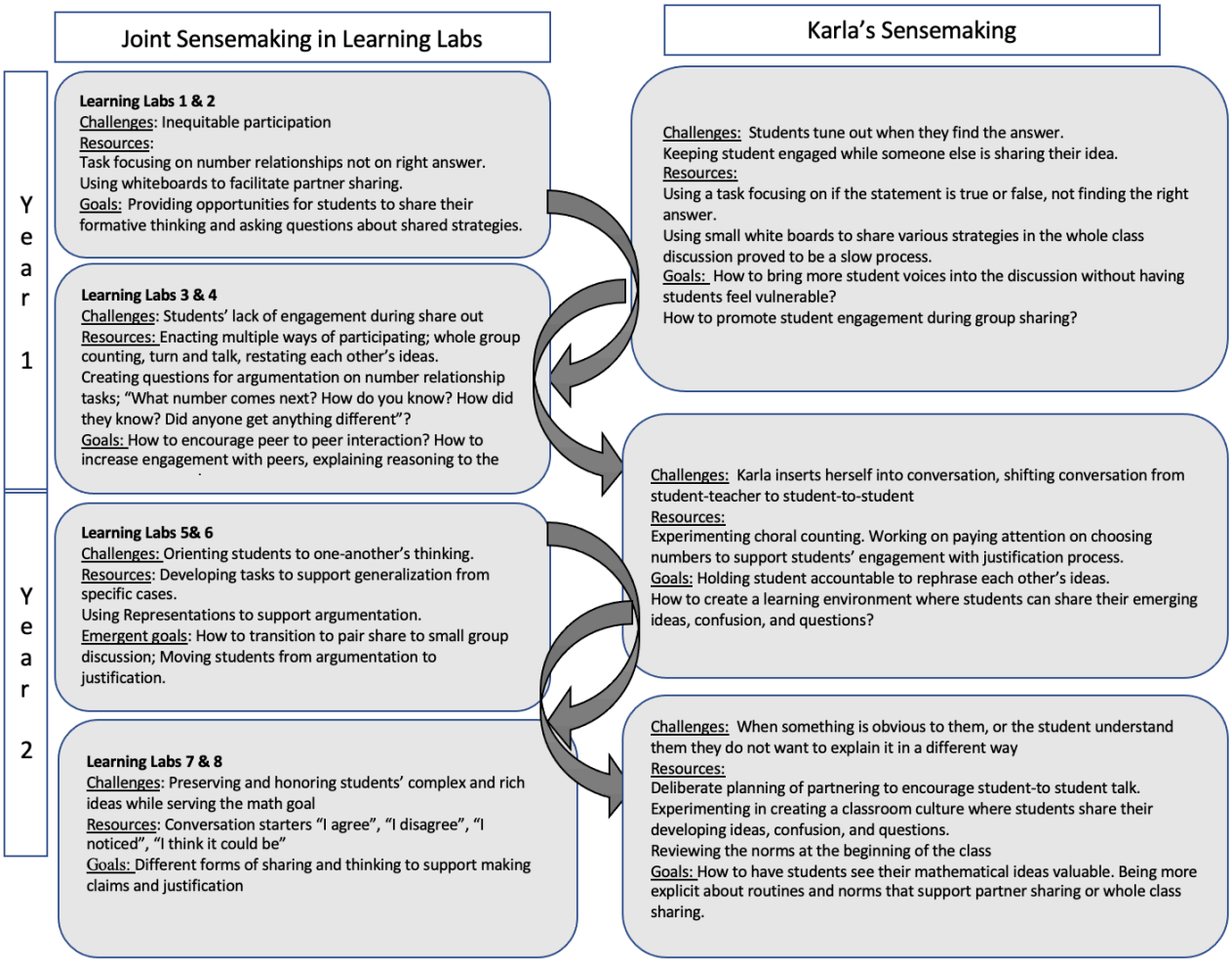

Figure 2: The Co-evolution of Challenges, Resources and Goals between Learning Labs and Karla's Practice

The participants' joint sensemaking in LL2 led them to identify this resource to address this problem: crafting tasks that focus on reasoning rather than a perceived *right answer*. Taking a cue from the group's suggestion, Karla experimented with the use of math tasks in her class where students needed to prove why a math statement was True/False. Reflecting on her work with her coach in the subsequent VSRI, she noted that unlike previous occasions when students tuned out after they had found an answer to a problem, students showed greater engagement, likely precipitated by the nature of the mathematical task whose central objective was not finding a final result, but the *process*. Yet, despite the changes she observed in overall engagement, the challenge of participation in her view continued to persist: some students still felt uncomfortable sharing in the whole-class setting, and Karla debated holding students accountable to sharing their partner's thinking as it may ruin the 'feeling of ... like, having a safe space to talk about math' (VSRI-2).

The subsequent two LLs (3 & 4) offered Karla opportunities to further think about student participation in whole class discussions. As participants grappled with students' hesitation to share during whole class discussions, they considered how *orienting students to each other's* thinking can support them in understanding each other's ideas and in representing those ideas to the whole class (LL3). They agreed on the importance of *monitoring students' positioning as sensemakers and creating connections between students' ideas* while orienting them to each other's work. In LL4, the participants further considered how being explicit about *the norms and practices of participation* in small and whole group discussions can bring in more students' voices. They also agreed on the importance of modeling and highlighting forms of participation that can be productive for everyone's learning. In her own teaching, Karla adapted these strategies to address her dilemma of surfacing mathematical ideas from students who are generally reluctant while ensuring these students don't feel vulnerable: She created a participation structure protocol to support students' sharing of each other's ideas, which she described in Interview 2 as:

> I still struggle with the small group, but the large group, we have a protocol we follow. So, you all get think time and then you talk to a neighbor and then someone shares out and then we think about what they said. We've done those steps several times. We've done them with the lab and then I've repeated them, so we have set steps that we do in large group. So that feels really good. It sets it up for some good discussions to happen because there's a lot of voices being heard. You're talking in a small group. You feel safe when you're talking to a partner. When you're sharing out, you feel safe because you can share your partner's idea. don't know, It's like when you're one voice of many in many it's not as ... You would think it would be scarier to share with the large group, but the way we've set up all the protocols is, "Just share an idea that you heard at your table." So, it's not your idea. It doesn't have to be your idea. (Interview 2, lines 94-100)

Through her lesson debriefs, Karla reported that the use of this protocol in her practice was productive for creating spaces where all students could engage in mathematics. She explained that such supports could disrupt students' negative mathematical identities, where students' ideas are positioned as valuable. Karla shared her classroom experiences with the participants in the subsequent LL4, elaborating her view of the consequences of students' acknowledging each other's contributions, "With Brian, who has this image of himself that he's not good at math, and he was the first one in the group to say four is half of eight. And like in a small group, I can hear that and point it out to him. And I often do it. You know you were the first one to say it, right? And you helped the whole group understand that" (LL4).

By the end of the first year of PD, Karla's reflections on the challenge of bringing more voices into the discussion moved away from binaries of whole group vs. small group. Her reflections on this challenge allowed her to consider an array of ways students can be supported to work with each other in both group structures. In the second year of the study, we continued seeing this shift in Karla's perspective due her continual sensemaking about strategies and pedagogical tools to create a safe environment for students—like tasks that invite multiple ways of participation and focus on mathematical thinking processes and creating norms for partner and whole-class sharing. Having noticed increased partner sharing and variety of student voices in the whole class discussions with the help of her pedagogical toolbox, Karla's problem of practice started shifting from student participation goals to supporting discussions in various group structures where she had minimal teacher intervention.

Discussion

In this study of the co-evolution of a teacher's participation between PD and her own practice, we aimed to attend to teacher learning as a process of continuous sensemaking rather than an outcome. We portrayed Karla's learning beyond simply taking up tools from PD to her practice where we used evidence from her participation in both contexts to show how the recontextualization of ideas and tools can lead to richer deliberations about problems of practice and ambitious teaching. Karla's iterative recontextualization of strategies from LLs to her practice and the additional questions she considered about practice suggest the way tools can mediate activity not only by translating abstract conceptual problems for beginners into a series of concrete steps, but also through the affordances (and sometimes constraints) it contributes to the development of their sensemaking and learning.

References

Althauser, K. (2015). Job-embedded professional development: Its impact on teacher self-efficacy and student performance. *Teacher Development*, *19*(2), 210-225.

Cordero-Siy, E., Prough, S., Alapala, B., & Ghousseini, H. (2021). Identifying and recontextualizing problems of practice in learning to facilitate discussions with argumentation. In D. Olanoff, K. Johnson, & S. Spitzer, (Eds.), *Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Philadelphia, PA.

Dennis, D.; & Hemmings, C. (2018). *Making the simple more complex: the influence of job-embedded professional development in supporting teacher expertise in reading*. https://doi.org/10.1111/lit.12172

Ensor, P. (2001). From preservice mathematics teacher education to beginning teaching: A study in recontextualizing. *Journal for Research in Mathematics Education*, *32*(3), 296-320.

Ghousseini, H., & Kazemi, E. (In Press). Professional learning tasks through job-embedded teacher professional development. In G. Stylianedes, J. Cai, & P. Kenney (eds.), *On the learning and teaching of mathematics: Research studies in honor of Edward A. Silver.*

Gomez Marchant, C. N., Park, H., Zhuang, Y., Foster, J. K., & Conner, A. (2021). Theory to practice: Prospective mathematics teachers' recontextualizing discourses surrounding collective argumentation. *Journal of Mathematics Teacher Education*, *24*(6), 671-699.

Greeno, G. (2005). Learning in Activity. In R. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (Cambridge Handbooks in Psychology, pp. 79-96). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511816833.007

Horn, I. S., & Little, J. W. (2010). Attending to problems of practice: Routines and resources for professional learning in teachers' workplace interactions. *American Educational Research Journal, 47*(1), 181-217.https://doi.org/10.3102/0002831209345158

Kazemi, E., & Hubbard, A. (2008). New directions for the design and study of professional development: Attending to the co-evolution of teachers' participation across contexts. *Journal of Teacher Education*, *59*(5), 428-441.

Kazemi, E., Ghousseini, H., Cordero-Siy, E., Prough, S., McVicar, E., & Fox, A. (2021). Supporting teacher learning about argumentation through adaptive, school-based professional development. *ZDM Mathematics Education*, *53*, 435-448. https://doi.org/10.1007/s11858-021-01242-5

Knudsen, J., Stevens, H., Lara-Meloy, T., Kim, H. J., & Shechtman, N. (2018). *Mathematical argumentation in middle school: The what, why, and how*. Corwin Press.

Lefstein, A., Vedder-Weiss, D., & Segal, A. (2020). Relocating research on teacher learning: Toward pedagogically productive talk. *Educational Researcher*, *49*(5), 360-368.

Makar, K., Bakker, A., & Ben-Zvi, D. (2015). Scaffolding norms of argumentation-based inquiry in a primary mathematics classroom. *ZDM*, *47*, 1107-1120.

Semon, S.; Lane, D.; Jones, P., & Smith, S.M. (2020). Job-embedded professional development: implementing co-teaching practices in general education classrooms. *International Journal of Inclusive Education.* https://doi.org/10.4324/9781315719693

Silver, E. A., Clark, L. M., Ghousseini, H. N., Charalambous, C. Y., & Sealy, J. T. (2007). Where is the mathematics? Examining teachers' mathematical learning opportunities in practice-based professional learning tasks. *Journal of Mathematics Teacher Education*, *10*(4), 261-277.

Stake, R. (2005). *Multiple case study analysis*. New York: The *Guilford Press*.
Walkoe, J. D., & Luna, M. J. (2020). What we are missing in studies of teacher learning: A call for microgenetic, interactional analyses to examine teacher learning processes. *Journal of the Learning Sciences*, *29*(2), 285-307.
Van Oers, B. (1998). The fallacy of decontextualization. *Mind, culture, and activity*, *5*(2), 135-142.
Zepeda, S. J. (2014). *Job-embedded professional development: Support, collaboration, and learning in schools*. Routledge. https://doi.org/10.4324/9781315719693