



EDITORIAL OPEN ACCESS

Understanding Science Teacher Learning as Situated in Organizational Contexts: Introduction to the Special Issue

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ABSTRACT

In this special issue, we feature scholarship focused on understanding the organizational context of science teacher learning. The special issue grew out of discussions among professional learning researchers and practitioners over the last several years that highlighted the following concerns: (a) that teacher learning in professional development showed up in vastly different ways in teachers' instructional practice; (b) that traditional research on the role of individual teacher traits (existing knowledge, skills, and beliefs) did not fully explain this variation; (c) that simply listing organizational features as barriers to teacher learning did not allow for a theoretical understanding of the interplay of teacher learning within organizations; and that (d) the existing literature that took up this interplay was not yet well known in the science education community. Together, these concerns signaled a need for a repertoire of work to support research and design practices that situate teacher learning within their organizations. The 14 original empirical and conceptual pieces that compose the special issue examine the ways teacher learning is shaped by the sociocultural and historical institutions of schooling that teachers work within and navigate as part of their daily practice. Teachers are positioned, not solely as conduits of reform nor as constrained actors within their organizational environment, but rather as agentive learners situated in complex contexts.

The work of this special issue mirrors the kinds of design features championed within the issue's articles. It began in scholarly relationships that were developed through mutual admiration, and germinated on a kayak trip during a conference in San Diego. The special issue grew and flourished through group gatherings at the National Association for Research in Science Teaching (NARST), culminating in a NARST invited poster session. Similar to the resources noted across many of the included studies, the collective learning featured in these articles was fostered through infrastructure (support from Science Education and NARST), a culture of collaboration (zoom sessions, group discussions of theory and methods), and relationships (mentoring, happy hours, laughing). This emergent process has culminated in a set of articles that examine, unpack, and challenge the concerns that sparked the special issue, providing new and innovative understandings. Enjoy!

1 | Vignette

At a conference some years ago, we were sitting in the audience for a set of presentations on science professional development (PD). The dialogue among the audience turned toward the various barriers that had been brought up by presenters: the teachers worried

about preparing students for accountability tests, there were no substitute teachers available, and district policies and norms emphasized quiet classrooms and teacher-centered instruction. In the face of these barriers, teachers adapted, hybridized, and even rejected the equity-focused or reform-based instructional practices championed by the PD. One of the audience members stood up and

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turned a pleading face to the whole audience, asking, “But what do we do about this? How do we, as PD designers, overcome these barriers? How do we help teachers and districts grapple with these issues?”

The kind of tensions this audience member surfaced are familiar for many of us in the fields of science education and teacher learning, and one that motivates (in part) this special issue. In what follows, we discuss the purpose of this special issue titled “Understanding Science Teacher Learning as Situated in Organizational Contexts,” summarize the emergent themes regarding the role of organizational contexts in shaping science teacher learning, and provide suggestions for future research that will move the field toward understanding science teacher learning as a complex phenomenon with design implications.

2 | Purpose: The Need to Bring an Organizational Lens to Teacher Learning

A large body of work has been devoted to understanding what teachers learn in PD (Darling-Hammond et al. 2017; Kennedy 2016) and which specific PD strategies impact teacher learning (e.g., content focus and active learning; Desimone 2009; Garet et al. 2001). While this body of work has established some consensus with regard to effective strategies, it has generated further questions as to why—despite effective strategies during PD—instructional change is so variable, and why teachers struggle to implement and sustain equity-focused or reform-based instructional practices such as those encouraged in the Framework for K-12 Science Education (Kennedy 2016; National Research Council [NRC] 2012; Longhurst et al. 2017).

Many studies of science teacher PD have indicated that teacher implementation of new instructional practices learned in PD is constrained by barriers in their organizational contexts (e.g., accountability policy; Fore et al. 2015; Kayumova and Buxton 2021). Yet, without theoretical frameworks to understand the function of these barriers (and supports), we cannot, as a science education community, leverage the organizational context as a design feature of effective PD. The need to clearly and theoretically articulate the role of organizational context in teacher learning and instructional change has been argued compellingly in several reviews of the literature (Boylan et al. 2018; Opfer and Pedder 2011; Whitworth and Chiu 2015). In science education, a few studies have begun to answer this call by attending to the situated, complex nature of teacher learning. These studies demonstrate the salience of the sociocultural and organizational contexts in which science teacher learning takes place (Allen 2023; Allen and Penuel 2015; Hayes et al. 2024; Heredia 2020), laying the groundwork for this special issue.

With this state of the literature as a backdrop, we conceptualized a special issue for *Science Education* principally concerned with scholarship that explores science teacher learning as a phenomenon situated within teachers' organizational contexts. Teachers' organizational contexts are broadly defined as including the socio-cultural context (norms, relationships, histories, collaboration approaches, and organizational culture) and the infrastructure and policy contexts (structures,

resources, and policies) of teachers' workplaces (Boylan et al. 2018; Opfer and Pedder 2011; Whitworth and Chiu 2015; Zafrani and Yarden 2022). These elements of teachers' context are imbued with values regarding best instructional practice, as well as implicit structures of power and privilege (e.g., racism, neoliberalism) (Ray 2019). Collectively, this constellation of organizational conditions influences how teachers engage in instructional change and are, in turn, interpreted, resisted, and re-constituted by teachers themselves as they learn.

This special issue was guided by the following broad questions:

1. How can we conceptualize and research the intersection of formal professional learning, instructional practice, and organizational contexts in science education?
2. How do we account for and leverage educators' organizational contexts in designing science teacher learning that supports complex adaptation and integration of new ideas and instructional practices?
3. What ways of framing research could promote fresh insights into the dynamics of teacher learning within their workplace environments?

In the following section, we discuss how the 14 papers in the special issue contribute to the literature empirically and theoretically. As we do so, we present several emergent themes that provide a way to conceptualize teacher learning and instructional change as a complex phenomenon situated in teachers' organizational context.

3 | Theme 1. Constellations of Organizational Features That Shape Teacher Learning and Instructional Change

3.1 | Theme 1a. Particular Organizational Features Constrain and Enable Teacher Learning

A common question from both practitioners and researchers concerns a practical consideration: What organizational features tend to constrain or enable science teacher learning? As noted below and across the special issue manuscripts, the phenomena of “organizational constraints” is complex, multifaceted, and not unidirectional. However, in the interest of a practical and actionable set of recommendations, we summarize below the organizational features foregrounded through this paper set.

Across the paper set, organizational features that were supportive of teacher learning included intensive professional learning (Shim and Thompson 2025; Makori et al. 2025; Von Esch et al. 2025; Hayes et al. 2025), school and district culture and time for collaboration (Tanas et al. 2025; Shim and Thompson 2025; Morrison Thomas and Anderson 2025), tools for sensemaking (e.g., unit planning structures; Shim and Thompson 2025), leadership support of science teacher learning and reform (Shim and Thompson 2025; Morrison Thomas and Anderson 2025), and opportunities for teacher leadership (Shim and Thompson 2025; Hayes et al. 2025). The surfacing of these supports across articles in the special issue echoes existing literature on organizational supports for teacher learning, affirming that materials, labs, and

curriculum may be necessary but insufficient organizational features for supporting science education reform (Allen and Penuel 2015; Longhurst et al. 2017), and districts and sites may want to hone their focus on the culture, tools, and practices of collaborative learning, and elevation of teachers as professionals and leaders (Gallucci 2008).

Constraints that emerged in these special issue articles were primarily focused on accountability and district-based assessment practices (Makori et al. 2025), which is also well established in the literature (Fore et al. 2015; Hayes et al. 2019; Heredia 2020; Sandholtz et al. 2019). Some organizational features acted to either enable or constrain teacher learning, depending on how they operated in context. These included the degree of teacher autonomy (Hayes et al. 2025; Lowell et al. 2024; Morrison Thomas and Anderson 2025), union policy (Morrison Thomas and Anderson 2025), and student reaction (Makori et al. 2025). For example, in Morrison Thomas and Anderson's (2025) study of how science instructional reform played out in two districts, the union played differential roles. In the district that was able to accomplish widespread instructional reform, the union supported teachers to participate in collaborative processes, both financially and in terms of policy. In the district that struggled to move beyond "common sense good teaching," the union did not prioritize collaboration, nor challenge norms of autonomy and privacy. In this way, institutional logics of privacy and noninterference were carried into the work of teacher learning.

3.2 | Theme 1b. Organizational Features Often Act Together to Enable or Constrain Change

The organizational features listed in the section above provide a simple roadmap for supporting reform; however, a major finding across papers was that these features do not stand alone, but interact with one another to produce particular reform outcomes. Several papers addressed how constellations of organizational resources together supported change. Without the presence of each organizational feature (including both cultural and structural resources), instructional change may have been less robust. For example, in Shim and Thompson's (2025) study, teachers worked together in a PLC to take ownership of their professional learning after a PD grant had ended. This was made possible by constellations of resources. Specifically, participation in 4 years of grant-funded professional learning built resources over time, including a culture of collaboration, a set of tools for sensemaking about curriculum, and teacher leadership. In the period following the professional learning, just-in-time cultural and structural supports from the district (e.g., time for collaboration) interacted with the resources from years of professional learning to sustain the PLC work and allow for deep learning about classroom practice. Hogan and Bae (2025) conducted a comparative case study across teacher teams. They found that teachers drew on various constellations of resources—internal, organizational, and external, to exert agency to implement student-centered instruction in the face of teacher-centered norms. These studies demonstrate that the presence of each resource or organizational feature was necessary in order for the others to be activated.

Constraints can also interact in ways that amplify one another to erode the potential for teacher integration of reform-based

instructional practice. For example, Makori et al. (2025) found that district and state assessment practices constrained teacher agency to change their instructional practice during PD. Interactions between these assessment practices, the beliefs of the teacher, and the reactions of students (based on their own habitus of rote learning after years of accountability) discouraged teachers' integration of learning from the PD into their instructional practice. Thus, addressing isolated organizational features (e.g., solely addressing a culture of collaboration or leadership support) may not result in the desired instructional change. To support teachers in making desired changes to their practice, reform planners should develop an understanding of which constellations are impacting current practice and foster constellations of resources and organizational features that together enable instructional change (Bryk et al. 2015; Manz et al. 2022; Penuel et al. 2022; Woulfin and Allen 2022).

3.3 | Theme 1c. Organizational Features Espouse Particular Values That Carry Meanings and Drive (or not) Instructional Change

Organizational features themselves are imbued with meanings and values that shape instruction. The prominence of these features and how they are taken up in organizational routines and practices have significant implications for teachers' learning and practice. Measures of effectiveness are a prime example of this, such as the ways that local measures for teacher evaluation or standardized assessments drive teacher decision-making (e.g., Heredia 2020). Anderson and Richards (2025) showcase metaphors for understanding the ways measures act within organizations. For example, measures can be carriers of local priorities, with implicit meanings and taken-for-granted values that influence practice in the context of professional learning. The authors surface the complexity associated with using practical measures to support professional learning (i.e., metaphor of "exercises") while also allowing for visibility into teachers' understandings and needs (i.e., metaphor of "windows"). They push us to consider how practical measures of teacher learning can act in multiple ways to both carry organizational priorities into teacher education and drive change in the organization itself. Findings from their work can inform how to design measures of teacher satisfaction and teacher learning that appropriately inform facilitation and resourcing of PD. This work around how organizational features such as measures carry values and shape instruction has particular implications for equity, as deficit perspectives of historically marginalized students can be embedded within measures and other organizational features (e.g., the "achievement gap").

4 | Theme 2. Interactional Dynamics Among Teachers and the Organizational Environment

4.1 | Theme 2a. Teachers Navigate, Negotiate, and Resist Organizational Constraints, Drawing on a Variety of Resources

Teachers actively navigate organizational constraints as they adopt and implement curriculum, with a range of outcomes for instructional reform (Carlone et al. 2010; Rodriguez 2015). In

their process of navigation, teachers draw on both internal and organizational resources to make sense of the organizational environment and make decisions. In some cases, such negotiation can result in “hybridized” or “recontextualized” instructional practices (Lindsay and Otero 2025; Von Esch et al. 2025). For example, Lindsay and Otero (2025) studied the ways teachers made sense of an NGSS-based instructional approach within a no-excuses charter network, which typically championed didactic instruction. As they engaged in sensemaking of both the reform and their organizational contexts, teachers “hybridized” their instructional practices, creating intentional blends between the two approaches so they could simultaneously “fit in” their organizational context and incorporate some NGSS-based pedagogies in their classrooms.

Power and privilege are also inherent aspects of the context teachers are navigating, necessitating a body of research that grounds teacher learning in the historical and socio-political discourses that permeate organizational contexts (Bang et al. 2013; Carlone et al. 2010; Allen and Eisenhart 2017). Studies in this area often highlight teacher resistance and “creative insubordination” as they navigate inequitable organizational contexts to teach in justice-centered ways (Carlone et al. 2010; R. Gutiérrez 2016). In the study by Wright et al. (2025), the district’s racialized and spatial narratives fostered deficit and racist interpretations of the learning capacity of historically marginalized students. Yet in the context of an engineering-focused professional learning community, the two case study teachers (both Black women) authored their own emerging engineering identities and took up teaching practices informed by imagined possibilities for themselves, their instruction, and their students. To engage in this re-authoring, they drew on various internal and relational resources—their identities, commitment to students, and knowledge of racialized institutional practices—to craft possible futures for marginalized students.

As teachers grapple with professional learning focused on equity and justice, they engage with tensions among what they are exposed to in the PD, existing organizational norms and values, and their existing beliefs and ideologies. For example, Reigh et al. (2025) described how a professional learning program supported teachers in examining their narratives about multilingual learners (MLLs). The teachers in their study shifted between asset- and deficit-based narratives about students and showed an awareness that traditional instructional approaches to language could undermine MLL engagement and sensemaking in science. However, their shift to transformative instructional practices was constrained by institutional barriers, such as standardized assessments of language proficiency and English-only policies. For example, teachers felt that preparing MLLs to do well on the state exam was also an “equity” issue (as it provided academic currency that was valuable for students). Despite these challenges, teachers deepened their sense of agency to implement new instructional strategies that centered MLLs’ cultural and linguistic strengths. The authors argue that professional learning focused on language in science should address not only teacher instructional practices but also the larger organizational systems related to language that perpetuate inequities for MLLs. Von Esch et al. (2025) also examined multilingual science teaching and learning, using socio-cultural

and critical post-human theory to understand teacher integration of multilingual student discourse and trans-language. They found that teachers engaged in a continual negotiation of context, cobbling together their learning, ideologies, and practice in ways that were both moderated and catalyzed by their multiple sociopolitical, school/district, and bilingual programmatic contexts. Teachers drew on resources both internally (student-centered ideologies) and externally (district PD) to engage in this negotiation.

4.2 | Theme 2b. The Role of Teacher Agency Depends on the Organizational Context

Scholars who use agency and similar concepts (e.g., teacher autonomy) to understand teacher learning in organizational contexts must contend with a particular tension: the degree to which the organizational context is consonant with the reform. This tension implies questions: If the organizational context is misaligned with instructional reform, do teachers need a certain degree of autonomy or agency within their organizational context to resist this misalignment? What is the role of professional learning in this resistance? Conversely, if the organizational context is highly aligned with the desired instructional reform, is reform-based instructional change more likely to occur if teacher agency and autonomy are low (i.e., high incentives or mandates for teachers to conform to reform-based teaching)? These questions have been explored in the broader literature (Coburn 2016; K. D. Gutiérrez and Calabrese Barton 2015; Marco-Bujosa et al. 2020), and taken up in several studies in this issue. Hayes et al. (2025) tested the role of 11 conceptually framed organizational conditions in predicting teacher self-efficacy and instructional practices in the context of PD. In the quantitative portion of this mixed-methods study, the only variables that significantly predicted equitable and NGSS-focused instruction were autonomy and a sense of professional impact, lending credence to literature arguing that teacher autonomy is necessary for growth in instructional practice (Pearson and Moomaw 2006; Short and Johnson 1994). Yet, qualitative findings showed that teachers could resist low organizational autonomy if they had developed their self-efficacy during their participation in the PD.

Lowell et al. (2024) also grappled with questions of teacher agency. They conducted a comparative case study across two districts, using organizational sensemaking to examine differences in implementation of NGSS-aligned materials. Teachers in the district with a focus on “fidelity” tended to use their agency to move the curriculum toward more traditional, teacher-centered practices. In contrast, in the district that provided time to make sense of curricular goals during collaborative PD, teachers made adaptations more consonant with the purpose of the reform.

Together these findings suggest that teachers may need a degree of organizational agency or autonomy to engage in reform-based teaching, pedagogies that tend to require continual reflection, adapting curriculum to center students, and a sense of professional responsibility (Cherbow 2023; Pearson and Moomaw 2006; Sandholtz et al. 2019; Szelei et al. 2020). Yet, for that agency to result in reformed instructional practice, teachers

also need strong and consistent professional learning opportunities, collaboration focused on the goals of the reform, and an open-door culture of sharing practice (Davis 2003; Lamb et al. 2011; Rivera Maulucci et al. 2015; Morrison Thomas and Anderson 2025).

4.3 | Theme 2c The Organizational Environment Is Co-Constructed in the Process of Teacher Learning

Consistent with the literature (Fore et al. 2015; Hayes et al. 2024; Kazemi and Hubbard 2008), papers in this set also point to the ways interactions between organizations and teacher learning are not unidirectional (i.e., the organization acts on the teacher). That is to say, teachers also act on the organizational environment, co-constructing new environments as they interact with leaders, processes, and other organizational features. Fazio et al. (2025) used the theory of practice architectures (Kemmis et al. 2014; Schatzki 2002) to show how attending to specific cultural-discursive, material-economic, and social-political arrangements can provide a platform for transforming these organizational aspects into spaces that support teacher learning in science education. They found that teachers, in the process of adapting and implementing environmental issues projects with their students, shifted the focus of their projects due to constraining and enabling conditions while simultaneously acting to change these conditions.

5 | Theme 3. Design Features for Supporting Teacher Learning in Organizational Contexts

As we gain a deeper understanding of the constellations of organizational features that shape teacher learning, we can begin distilling these insights into PD design. For instance, a fruitful area of recent literature urges PD providers to consider embedding intentional organizational sensemaking opportunities into science teacher PD (Allen and Heredia 2021; Penuel et al. 2022). Such approaches can allow teachers to reason through curricular goals, the purpose behind reform, and how to attend to conflicts between reform and organizational practices and expectations. Scholarship in this issue builds on this call. For example, Porter and Allen (2024) studied teachers' sensemaking of students' out-of-school time experiences as a means for supporting student learning and identity work within a PD context. Drawing on Allen and Heredia's (2021) framework for designing PD, they examined instances in which teachers' organizational sensemaking was intentionally surfaced within the PD context and how that supported teachers' learning. They found that science teachers drew on their organizational knowledge (Allen 2023) as a means for interpreting the learning available to students; and that while they initially viewed the out-of-school learning environment as inadequately attending to school-based expectations (e.g., a focus on science vocabulary), over time teachers came to see the out-of-school learning environment as necessarily distinct from school science learning, affording greater opportunities for student participation and affiliation with STEM not provided in traditional school settings. Their findings suggest the

importance of designing for teacher learning in ways that understand teachers as actors within STEM learning ecosystems and that intentionally integrate conflicting goals into PD.

Lindsay and Otero (2025) also adopted Allen and Heredia's model (2021) to support teacher sensemaking of an NGSS-based instructional approach during PD, studying teacher integration of the reform instruction within a no-excuses charter school network. Their analysis highlighted the ways that intentionally facilitated organizational sensemaking during PD enabled teachers' development of hybridized practices between the rigid protocols of their school context and approaches that prioritize students' epistemic authority in the science classroom. Furthermore, these aforementioned studies highlight the importance of sustained effort over time, supported by PD. In many cases, the learning that unfolded for teachers was dependent on engagement with reform ideas through PD, classroom implementation, and materials development over multiple years (e.g., Lindsay and Otero 2025; Shim and Thompson 2025).

Tanas et al. (2025) offer a framework that blends organizational culture and organizational climate in studies of science teacher learning as a means for noticing the organizational conditions that impact learning and matter for future designs. They argue that taking such an approach can, in particular, surface dynamics related to coherence (Heredia 2020).

6 | Discussion: Advancing the Field of Science Teacher Learning in Organizational Contexts

We (the editors) are incredibly pleased and impressed with the articles in this special issue. Together the papers call out teachers as actors and learners situated within broader complex systems, where learning is not linear but interstitial, hybrid, and iterative. They surface critical aspects of this process and lay out potential considerations for professional learning design. We summarize these aspects and need for additional research below.

First, specific features of organizational contexts can shape how and why teachers engage in instructional change, particularly organizational culture, the nature and focus of professional learning, and various state and local policies. More research is needed on how these features interact with one another, with teachers' existing beliefs, identities and skills, and with professional learning itself. We need to understand what organizational features can and should be brought into interaction purposefully to support equity-focused, reform-based instructional change in science education. How do organizational features carry meanings and values into instructional practice? What features are necessary but not sufficient? Key theoretical approaches to conceptualizing this area include frameworks of instructional capacity (Hayes et al. 2020, 2025; Hogan and Bae 2025; Shim and Thompson 2025; Spillane et al. 1997) and infrastructure (Shirrell et al. 2019), socio-ecological systems (Capra and Luisi 2014; K. D. Gutiérrez and Rogoff 2003; McGowan et al. 2023; Porter and Allen 2024), organizational theories of measurement (Anderson and Richards 2025; Bryk et al. 2015; Takahashi et al. 2022), and situated learning (Lave and Wenger 1991; Shim and Thompson 2025; Von Esch

et al. 2025). Understanding such interactions can provide districts and school sites, as well as PD providers, with tools to support sustainable instructional reform.

Second, teachers actively navigate their organizational context and exert agency in how they adapt and hybridize reform-based instructional practices. Future research can build on the salient contributions of this special issue by exploring the nature and degree of teacher agency in both PD and the organizational context that is needed to foster teachers' sense of professionalism and responsibility. What types of "hybridization" of instructional practices represent "principled improvisation" and which represent maladaptations, and how does teacher agency influence the nature and extent of hybridization (Cherbow 2023)? What are the stepping stones of teacher sensemaking toward principled improvisation? Understanding how and why teachers engage in particular navigation and hybridization processes will support deeper theorizations of teacher learning and productive design of professional learning. Future research in this area will benefit from theoretical approaches such as organizational sensemaking (Porter and Allen 2024; Allen and Penuel 2015; Lindsay and Otero 2025; Lowell et al. 2024; Marshall et al. 2021; Weick 1995), structure/agency dialectic (Giddens 1984; Fazio et al. 2025; K. D. Gutiérrez and Calabrese Barton 2015; Hogan and Bae 2025; Makori et al. 2025; Reigh et al. 2025), and theories of teacher resistance (Carlone et al. 2010; R. Gutiérrez 2016).

Third, teachers resource their navigations in a variety of ways, including individual knowledge, skill, and identity (e.g., sharing an identity with students; Allen 2023; Lindsay and Otero 2025; Wright et al. 2025), discursive resources (e.g., asset-based conceptualizations of students among teachers; Reigh et al. 2025; Carlone et al. 2010; Allen and Einsehart 2017), and organizational resources (e.g., district-based PD; Von Esch et al. 2025). Teachers' "infrastructuring" can aid in supporting instructional change; however, the resources teachers draw on can also work to reaffirm more traditional views and practices that can inhibit change. Since this is an under-researched area, we hope to see additional research specifically focusing on how teachers infrastructure their own reform processes (Shirrell et al. 2019). What resources, both within and around them, do teachers draw on when they resist teacher-centered and inequitable features of the organizational environment? Which resources (such as discourses about teaching and learning) seem particularly resistant to change and how might these be addressed in PD contexts (Reigh et al. 2025)? What additional resources (e.g., social, cognitive, material) can PD provide to support the sensemaking of reform goals and organizational context? Conceptual frames that might support such inquiry include organizational sensemaking (see above for references), institutional theory and institutional logic (Anderson and Colyvas 2021; Thornton and Ocasio 2008; Morrison Thomas and Anderson 2025; Zafrani and Yarden 2022), and infrastructure (Hopkins et al. 2013; Seeber et al. 2024).

Fourth, there is a need to recognize the ways power and privilege inform and shape teachers' experiences as actors situated within broader schooling ecologies (e.g., Porter and Allen 2024; Wright et al. 2025). Such perspectives can support an understanding of how teachers bring multiple, intersecting identities to their learning and teaching practice and the implications of

this for learning designs. While teachers may be committed to equity, they often exist within teaching and learning contexts that are imbued with deficit framings of students (Carlone et al. 2010) and settled practices regarding science teaching and learning (Bang et al. 2013). As we develop deeper understandings of science teacher learning in context, there is a need to adopt critical perspectives (Woulfin and Allen 2022) that surface the dynamics of power of privilege which shape teachers' experiences and decision-making. It is important to explicitly ask how race, gender, organizational role, and other manifestations of power (Ray 2019) shape (and are shaped by) teacher learning. More research is needed that explicitly considers science teacher learning in context from a critical lens. Theories that offer generative understanding in this area include racialized organizations (Ray 2019), critical theory (Giroux 2024; Kincheloe and McLaren 2011), and social practice theory (Holland and Lave 2009).

Finally, it is clear that teachers-as-learners co-construct their organizational environment (and their interpretations of their environment) in the process of learning and instructional change. Likewise, PD providers, whether internal or external to the district, influence the organizational environment. How practices, tools, and underlying values become embedded and reified in organizational routines greatly influences what is taken up and sustained (Anderson and Richards 2025; Penuel 2019a; Reigh et al. 2025). Because of these processes, co-design of professional learning holds great promise to support deeper reform internalization and more complex systems change (Coburn 2016; Penuel 2019b). Such design approaches consider teachers' and leaders' holistic and complex contexts, as well as the nonlinear nature of teacher learning. Theoretical supports for this approach include design-based, participatory research (Bang and Vossoughi 2016), improvement science (Bryk et al. 2015), infrastructure (Penuel 2019b), critical approaches to posthumanism (Deleuze and Guattari 1987; Strom and Martin 2022), and practice architectures (Fazio et al. 2025; Kemmis et al. 2014; Schatzki 2002).

In conclusion, the articles in this special issue move the field of science teacher learning forward, providing both empirical evidence and conceptual framing for understanding science teacher learning as a phenomenon situated within teachers' organizational contexts. They also lay out a set of recommendations for PD providers, including the need to provide space for organizational sensemaking and to support teachers in navigating or resisting aspects of the organizational environment that discourage equitable, student-centered, social-constructivist science learning. We hope this special issue serves as a foundation for future generative research.

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