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The Power of Scaling Slowly: Negotiation of Science Teaching in a Long Term Research-Practice Partnership

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Abstract: Moving innovations in education from small initial efforts to broader impacts has been a central challenge of supporting change in schools. This study is a part of a larger design-based research project where we worked in partnership to redesign the secondary science program at The Pennsylvania State University. We used the context as a test-bed for innovations and design-based research to develop "humble" theory and contest theory in teacher education. This study views teacher learning as the sociocultural practice of negotiation of professional vision within a community in broad temporal and physical scales. Professional vision is theorized not as a small scale, local negotiation of individual acts of practice, but as the on-going and dynamic collaborative negotiation of a learning community in response to the overlapping political economies of social organizations that occurs across different sites, places, or contexts, spanning decades.

Subject/Problem

Changing educational systems, and particularly the embedded cultural practices of teaching, requires in-depth, rich, extended engagement focused on building and sustaining trusting relationships. Characterizing this kind of change lies at the intersection of systems of community and individual learning, which are naturally intertwined. To address this complexity and support system change requires the cultivations of a learning environment for multiple role actors (e.g, preservice and in-service teachers, students, university faculty) and as a result involves bridging multiple cultural communities. While teacher learning occurs both in (and outside of) institutions of higher education and K-12 schools, the relationships between these two institutional contexts are often complicated. The culture and practices of K-12 institutional contexts often operate in tension with those of institutions of higher education, described as the two-worlds problem (Braaten, 2018). This tension complicates efforts at systemic change as do the multiple layers of practice involved in the culture of schools (Windschitl & Stroupe, 2017) - students engaged in science practices (as articulated by documents like the National Research Council's Framework for K-12 Science Education or the Next Generation Science Standards); teachers engaged in designing and enacting learning environments to support students science practices (as articulated by documents/frameworks like Ambitious Science Teaching); and teacher educators engaged in designing and enacting learning environments for teachers (both in-service and preservice) to develop teachers' practices (by extension, Ambitious Science Teacher Education). This multi-layer complex of interwoven practices contributes to the massive challenge facing attempts to change the culture of schooling, and of particular concern to us, science teaching as a cultural practice.

Approaches to supporting these complex cultural shifts frequently involve attempts to "scale-up" changes, most often via curricular interventions in combination with distributed professional learning (e.g., Edelson, et al., 2021). While there has been success with change at scale, at least at the level of school districts attempts at large-scale change are mixed (e.g. Spillane, et al., 2018), generally have been shown to impact only smaller groups of "maverick" teachers more directly engaged with funded projects, or produce superficial changes in practice leaving the instructional core relatively stable (Cuban, 2013). Repeated efforts to change practice over time can also lead to a kind of change exhaustion, where teachers see all change efforts as transitory and choose to wait them out (Del Schalock, 2006).

This manuscript describes an approach to school change that conceptualizes scaling in a long-term and organic way. The context is a 15+ year research-practice partnership built around a core community of secondary in-service science teachers, science teacher educators, preservice secondary science teachers, and middle school students. Participants are in multiple overlapping professional learning experiences, but given our roles our narrative focuses on one activity of the community - an embedded, practice-based science teacher preparation program. The beginning of the partnership is retroactively marked by the meeting of members in 2006 and more officially and externally recognized with a more intentional and structured community of teacher learning that began to form five years later. Regardless, the consistent focus of the community has been on the negotiation and transformation of the cultural practices of science teaching and the intimately related transformation of the identities of the individuals of the community and their institutional contexts – their university, their schools, and more distal impacts on other schools, the state, and the field of science education.

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Organizational structures are fundamentally dynamic, cultural, and porous. They are constantly being created and recreated by the interactions of the participants that make them up. As participants move between contexts they carry with them and create anew their identities as members of their multiple communities. They are constantly negotiating the work of those communities and how the present set of participants are constructing the meaning of that work. There is historicity to this process, which constrains and affords the possible work of participants and frames their on-going negotiation of meaning. To understand the nature of the organizational interactions (and change) that occur via more localized negotiations of meaning, there is a need to attend to interactions across scales. To see how small moments of interaction and negotiation construct patterns over time and (re)create the constituent communities.

Much of the research on organizational change attends to macro scale, change is typically addressed via policies (including curricula and assessments) or other formalized components of organizations (e.g. Spillane, et al., 2018). Other approaches attempt to study change by focusing on micro-scale negotiation of meaning occurring between participants in classrooms or in professional learning contexts (e.g. Gomoll, Hmelo-Silver, & Šabanović, 2022). There is also a meso-scale, the stories and negotiated meanings that are created at the micro-scale and bridge to the creation and reification of macro-scale formalisms. As participants move through various contexts their pathways intertwine and separate creating a temporal fabric as imagined by Kurt Vonnegut's Tralfamadorians, who see human lives as a kind of temporal skein of yarn. This fabric is woven of stories told between participants about themselves and each other across the contexts that make up their lives and their community participation.

To successfully cultivate change in these tapestries of human interaction, we need to attend not just to the individual interactions, or the structure of the entire fabric; we need to think about the creation of learning environments as the creation of space to allow others to become new people, to create new selves that reflect new meanings they have negotiated with each other. To conceptualize this process we draw upon professional vision (Goodwin, 1994) to help us understand these social negotiations and how they continually recreate professional communities and their practices. Professional vision is not the particular lens an individual uses to view social interactions, it is a description of the stabilities and instabilities created by participants through the negotiation of meaning in a communities' social practices over time.

Conceptual/Theoretical framework

> "Knowing is inherent in the growth and transformation of identities and it is located in relations among practitioners, their practice, the artifacts of that practice, and the social organization and political economy of communities of practice" (Lave & Wenger, 1989, p. 122).

Theoretical understandings of and research on teacher learning is often limited by its contextual focus (e.g., universities, schools, professional learning activities) or the conceptualization of teacher learning as individual/cognitive (e.g., knowledge framed as Pedagogical Content Knowledge, beliefs, or dispositions), which often carries with it a deficit framing (Gray, McDonald, & Stroupe, 2022). In contrast, this study views teacher learning as a sociocultural practice of negotiation of professional vision (Goodwin, 1994) within a teacher community of practice at broad temporal and physical scales. We focus not only on a group of teachers in a single context negotiating a current set of dilemmas regarding changing practice (e.g., McCausland et al., 2023), but as a defining characteristic of an on-going, historical, and dynamic learning community that occurs across different sites, places, or contexts, as well as spanning years of collaborative negotiation, all of which is in response to the overlapping political economies of relevant social organizations.

Communities of Practice (Lave & Wenger, 1991) is a well-established framing of how people learn focused on social practice as not just the mechanism of learning, but the definition of the outcome of learning. Learning is viewed as a change in practice, both of the individuals in the community, but also, in interaction with the changes in the norms and practices of the community. Similarly, individuals' learning can be thought of as changes in identity within the community that are negotiated and manifest through practice with other participants in the community. One of the core pieces of this process identified by Wenger, is the negotiation of meaning. The term negotiation tends to evoke a discourse or even an argument, in the argumentation sense of that concept, between members of a community about the meaning of their practice; however, negotiation is more subtle and implicit in communities of practice. It entails subtle shifts in what is acceptable practice and talk that happen as groups of individuals determine what it is that defines the collective work of their profession. In short, it is a negotiation of professional vision.

Over the past ten or more years, Goodwin's (1994) original notion has often been taken up as a more individually cognitive focused notion (e.g., vanEs & Sherin, 2021), characterizing professional vision as a sort of

individual lens for viewing teaching and guiding individual's decision making. We take a broader and more practice focused conception directly grounded in Goodwin's original notion:

> "Discursive practices are used by members of a profession to shape events in the domains subject to their professional scrutiny. The shaping process creates the *objects of knowledge* that become the insignia of a profession's craft: the theories, artifacts, and bodies of expertise that distinguish it from other professions. Analysis of the methods used by members of a community to build and contest the events that structure their lifeworld contributes to the development of a practice-based theory of knowledge and action." (italics added, 1994, p. 606)

It is this building and contesting that we consider to be a characterization of the negotiation of meaning that occurs in communities of practice. This kind of social negotiation is not only seen in the minute-to-minute discourse between members of a professional community (McCausland et al., 2023), but also in how those members draw on other external communities they participate in, for example, to play with policies cutting across organizational levels of a system (Bateman & McDonald, 2023). Professional vision's social negotiation focuses on how community norms and understandings shift over longer periods of time and are reflected in the reified and tacit activities of those communities. This can be seen in how teachers change the focus of their own professional learning, the problems of practice they identify, and ideally how those problems without ceilings (Thompson, 2015) are continually renegotiated as the community deepens their understanding of their own goals and practices.

Our work uses this more community negotiation focused framing of professional vision as a key construct of analysis to determine the dynamically negotiated objects of knowledge that form the core of a learning community. For the research community to move beyond less productive and deficit framings of professional learning that proliferate in the field such as short term (e.g. one week) sessions or narrowly focused session (e.g. targeting particular curriculum or content topics), we need to have ways of investigating teacher learning at different grain-sizes and scales which conceptualize teacher learning as the complex and embedded social practice that it is. This manuscript is an attempt to tell a richer story of the organic origin, development, and eventual design-based evolution of a community of teacher learning thorough the negotiation of meaning done to establish the objects of knowledge that make up professional vision. Specifically, we address the research questions: 1) What are the patterns of growth and development of the objects of knowledge for a teacher learning community that intentionally interweaves university and school contexts? 2) What attributes seem to support the long-term engagement, growth, and learning of such a teacher learning community?

Design/Procedure

The research-practice partnership in this study developed over the course of 15+ years. In that time, numerous funded and unfunded research projects took place, hundreds of pre-service science teachers were educated, thousands of K-12 science students were impacted, and generations of science education researchers were a part of participating in and investigating teacher learning within the partnership. We say this to indicate the context we are describing is complex both temporally and socially. To attempt to capture this complexity, to describe how the partnership negotiated science teaching and learning over time (Goodwin, 1994), we recognized that traditional qualitative coding of interactions would not suffice, so we turned to narrative methods. By using narrative methods, we can navigate temporal, social, and contextual boundaries to communicate and transmit complex knowledge (Huber et al., 2016) about a dynamic social system of learning.

Narrative methods allow us to show how educational contexts might be transformed and render visible "things heretofore unnoticed" (Lewis, 2011, p 504) by telling "real stories" (Gallagher, 2011) that can help shift practices and pedagogies. In fact, narrative methods make it possible to capture the people, places, and events that occur over time in relation to learning. By telling stories it is possible to weave together learning and the context in which learning happens because as Clandinin and Connelly (2000) state, "People are individuals and need to be understood as such, but they cannot be understood only as individuals. They are always in relation, always in a social context" (p. 2). So, while narrative methods are used to delve into an individual's experience, they can also be used as "an exploration of the social, cultural and institutional narratives within which individual's experiences are constituted, shaped, expressed and enacted - but in a way that begins and ends that inquiry in the storied lives of the people involved" (Clandinin & Rosiek, 2007, p 42).

To gather the narratives, we generated stories based on our memory and we contacted preservice teachers, mentor teachers, and others involved in the community over time to describe "your experience and what you feel are key takeaways about how students learn science and how teachers learn to teach." Part of this process included revisiting data, that included video, audio, and documents, from previous funded and unfunded projects

and articles written that focused on actors in the partnership to help create a timeline of events, confirm particular stories, and support our narration of how the partnership grew over time.

Once we gathered the data, we constructed narratives through a process of mutual storytelling to explain the learning in context rather than produce a cause-and-effect relationship (Connelly & Clandinin, 1990). Our process took the form of writing and rewriting narratives based on moments in the larger data corpus that stood out as important (Maclure, 2013). The stories demonstrated the tensions, successes, and serendipitous moments involved in the development of the partnership to help demonstrate the negotiations (i.e. learning) that occurred within it (Rodriguez & Morrison, 2019). Finally, we took the narrative(s) and embedded theory to help us make "connections" between learning and the "individual lives" of the participants and discern the "order and pattern" (Maclure, 2013, p. 229) necessary to produce "humble" theory (Cobb et al., 2003) that goes beyond a report of "what happened." Below is an abridged narrative intended to provide insight into the data, findings, and analysis.

Findings and analysis

In 2004, when Scott (Author 1) arrived as a new Assistant Professor at a large research university in the Mid-Atlantic, there was an existing partnership, in the form of a Professional Development School, between the local school district and the university; however, it did not include secondary science teachers. Scott began teaching science methods courses that focused on enactment of inquiry science teaching, specifically the nature of authenticity in science teaching (McDonald & Songer, 2008). Serendipitously, Eliot, who eventually became a mentor teacher in the partnership school, was a student in that course. Describing his initial experience in the methods course, Eliot said, "I remember coming in focusing more on what I thought were the important parts of being a teacher - things like developing lesson plans and nice-looking assessments. Those classes convinced me of the importance of a more student-centered class, but I had no idea how that might look in my future classroom." Other preservice teachers felt similarly. In fact, many of the in-service teachers in the program, like Julia, who was also a graduate from Scott's university teacher education program, describe feeling dissatisfied with their science teaching practice early in their career as they had a vision of what was possible, but did not feel prepared to enact that vision in their classrooms. For instance, Julia, reflecting on her early career, exclaimed, "My first several years as a teacher in the science classroom were spent using traditional teaching methods, basically I tried to mimic what I had seen in school that I thought of as good teaching." Given this, Julia, Eliot, and other in-service teachers from this time describe focusing more on delivering content to students through teacher-centric ways then mixing in "labs" to provide "hands-on" experiences to students.

Over the next five years, in the context of research projects and methods courses, the community, now including various doctoral students in addition to preservice teachers, focused on the negotiation of an object of knowledge - inquiry science teaching. In 2009, Eliot returned to teach in the local school district at Brakebills Middle School (BMS). During that time the objects of knowledge began to move away from a negotiation of inquiry as characterized in the National Science Education Standards. This coincided with Scott receiving funding from the National Science Foundation with a pedagogical focus on coherent content storylines (McDonald & Kelly, 2007) and a claims, evidence, and reasoning framing of student discourse (Zembal-Saul et al., 2013) that included the development of an extended series of week-long professional learning workshops for science teachers. The change in focus and period of the partnership is reflective of a more traditional scaling of educational innovation, using curricula and professional development, due to the influx of funding designed to help increase the reach of Scott's work.

At this same time, Scott's research and pedagogy in the methods course and professional development workshops were transformed into design-based contexts for the study of the learning of science teachers. This also significantly expanded the participants directly engaged in negotiation of professional vision to include other faculty, including disciplinary scientists and educational scholars, as well as science teachers from across the state, including teachers in seven schools from both urban and rural contexts.

In 2011, Eliot, Julia, and other teachers at BMS participated in the NSF supported workshops. Julia recalls the professional learning being "overwhelming" saying, "I could see a lot of potential, but it was an entirely different pedagogy that I needed to learn, so it would be a large time investment." Julia also said she was grateful to have "support" from colleagues and university personnel to transform her pedagogy. While some teachers from the project stayed in contact with Scott, Eliot, Julia, their colleagues began to meet regularly to continue to figure out how to implement the pedagogy they learned, with intermittent visits from Scott. Eventually, these meetings led to them to negotiate questions of how to implement what was just beginning to be referred to as Ambitious Science Teaching (Windschitl et al., 2018; AST), a pedagogical framework rooted in four core sets of teaching practices. Again, the objects of knowledge being negotiated within the community's professional vision shifted, not entirely away from content storylines or claims, evidence, and reasoning, but to a more complex enactment of science teaching that included model-based inquiry because the educators in the partnership saw AST as a way

to radically transform their pedagogy, not just shift their curriculum in what they had seen as small, albeit productive ways.

At BMS the following Fall, Eliot, Julia, and one other colleague began to meet regularly to figure out how to implement AST in their classrooms with intermittent visits from Scott. The in-service group were negotiating how science should be taught and, increasingly, overtime, aligning their professional vision with AST. At this point in the narrative, the institutional contexts of the school(s) and the university were largely separate, with the main bridge being Scott's participation in both. The professional learning for practicing teachers and the professional learning of the preservice teachers in the University program were becoming more aligned, but remained largely parallel in practice, not intertwined. This is because while Scott was able to carry the language across the two communities, the practices were less portable, and the preservice teachers needed more direct access to the pedagogies in practice to be able to understand them. This meant that preservice teachers were generally learning to talk the talk without learning to walk the walk. What was needed was for the negotiation of knowledge objects to involve both preservice and inservice teachers directly in the context of practice with students.

An obvious broad category of knowledge object negotiated throughout the lifetime of the community focused on how science is taught. For example, throughout all the narratives preservice teachers, in-service teachers, and teacher educators worked together to identify, describe, and practice AST. Although AST is articulated in the literature, the community worked together to negotiate how AST could be adapted and transformed in purposeful ways that helped everyone "get somewhere" in relation to dilemmas in science teaching (Grimes, McDonald, & van Kampen, 2018; Windschitl, 2002). Throughout the negotiation of science teaching, preservice teachers, mentors, and teacher educators were willing to start and end with different perspectives (e.g. McCausland, et al., 2023), but collectively were committed to refining the ways they taught science. There were specific knowledge objects that were consistently present in the negotiations and were continually negotiated as part of the practice of the community.

Eventually, in 2015, Scott, alongside the teachers at BMS, and two graduate students including JD (Author 2), found a way to embed one of the two methods courses in the secondary science teacher education program in the classrooms of the five 7th and 8th grade science teachers at BMS. As a result of this shift to intentionally include university preservice teachers in the partnership in a more intensive way, new knowledge objects emerged because the preservice teachers and mentors held different perspectives on science teaching (McDonald, 2016). These knowledge objects characterized the nature of the negotiations occurring in the context.

Many of the preservice teachers arrive in the first methods course confident in their science knowledge and, by extension, their ability to teach. For example, Janet, said she had learned one rule from her previous teacher education experiences at the university, "teaching is repeated, not innovated." Explaining her point, Janet emphasized, "I had gone through every class setup for an education major, with the same process for each one: sit through a lecture, write down the major methods described for giving lessons and designing assessments, and repeat that information on an exam." From this, Janet was, "happy to sit down and learn how to make a slideshow that included information on a topic" or to "learn how to not just create lecture materials, but create lecture materials about something specific, like plant anatomy or genetics," but Janet was not ready to be "challenged" and "did not anticipate being challenged" in science methods. Other preservice teachers affirmed this. For example, Eliot described himself as, "I had a very different and narrow view of the education field. I believed it was a very individual career… It was a repetition of lecturing, homework, and testing. A structured system of delivering content that has been around for decades." Like Janet, and many of their peers, many of the preservice teachers as science teaching like Eliot did in 2004; a job focused on delivering content effectively to students in a teacher-centered way.

The teacher education team and the mentors maintain a perspective that is different from telling students, by way of lecture, information about the natural world. This perspective is highlighted by an preservice teacher, Penny, who, in retrospect describes the first methods course by saying, "This was when I really started to realize that giving students large amounts of information wasn't teaching them. Teaching science involves helping students to answer questions and draw conclusions by using their ideas, concepts, and skills." This is reaffirmed by Leonard who said, "What I realized was that presenting a student with a fact is different from them learning new information. More so, "explaining" is extraordinarily different from teaching." In other words, the first science methods course became and is a context where preservice teachers negotiate the role of content versus process in science teaching, mirroring the early negotiations of Eliot, Julia, and other mentor teachers early in their careers.

As the preservice teachers enter the second methods course and join the BMS mentors, they are pushed to refine their practice of AST. Specifically, the mentors and preservice teachers work together to negotiate a version of AST that is rooted in relationships. For example, Allie, describing their time in BMS, stated, "One of

the biggest takeaways for me is that it is okay for students to see a teacher feeling vulnerable… this creates a learning environment where students are comfortable asking questions… and also being wrong a few times." This is affirmed by Eliot and Julia. For example, Eliot stated, "I have wondered at times, and even said to various preservice teachers, that in some ways it might be easier to have less content knowledge, that way you really are more prone to responding to student questions with 'I don't know.'" This is affirmed by Julia who claimed, "In the AST classroom, relationships are not just essential for classroom management, but they are also used to build the trust needed for emotional safety… As an AST teacher, I always make sure that students can see examples of how I make my thinking visible so that they can see me being vulnerable with them. For Julia this helps students to not see her "as a source of information" but see her "as a person with experience who can facilitate using science to find the answers to their questions. So, I work with them to find a way we can test their questions and find the answer that they seek." What this reveals is that the preservice teachers and mentors are negotiating the process of AST with building relationships with students. In other words, they are working to enact a relational form of AST that decenters content knowledge and instead prioritizes cultivating relationships of trust that support classroom communities in talking about and participating in science discourse.

2015 also marked the arrival of JD, another former undergraduate student of Scott who was not part of teacher education at PSU. JD was a PhD student at the time and was interested in more justice-centered ways of teaching science. JD was unconvinced that AST was "truly" equitable, and this led JD to introduce questions of how to negotiate white supremacy in science teaching. What emerged was a negotiation, on the part of the preservice teachers, mentors, and teacher educators, around how to create equity in their classrooms. Highlighted by Emily, a preservice teacher, describing their mentor, Josh, by saying, "Josh has set up the class so that almost always, the students get individual thinking time, table discussion time, and then full class discussion time… this really allows ALL students to get a chance to participate." Going further, Emily explained how for her and Josh, "Participation has a huge relationship with equity in the classroom. When you don't create space for all students to have some mode of sharing, you are excluding a student from that resource and are limiting their learning… We need that collaborative participation set up in the classroom for expansion to occur with ideas." What Emily did not know was that in the previous year, Josh was challenged by a preservice teacher to think about participation because his class was characterized by the participation of boys and the silence of girls. A year later, Emily noticed the shifts in how the class is structured. In fact, as COVID-19 lockdown impacted schools, Eliot noticed how, "every student, from the most outspoken to the quietest, were participating. The chat was always flowing with ideas, questions, and conversations between students." From these negotiations came norms, across the community, described by Emily that included making sure "all ideas are visible to the community and accepted. No idea is discarded or judged, but instead, are grappled with," among other things.

The negotiations around equity also included making sense of race and systems of oppression and their role in science teaching and learning. For instance, in 2016, two White preservice teachers noticed that one Black boy was not participating as much as their White peers when they taught. Prompted by JD to spend some time investigating, they both realized that the Black boy participated more often when interacting with Herald, their mentor, because "Herald doesn't care what the student says, when they talk, Herald just asks him questions and he gets really excited and says a lot of good science stuff. I think we need to do more of that." This same conversation happened with Janet, in 2022 who, in working with Julia, developed procedures for increasing the participation of students with disabilities thanks to Janet's noticings on an assignment that was created the year prior in 2021. An assignment that, coincidentally, was created by research Emily did in 2020 alongside Scott and JD that found that, "special education students can participate, and participate at a high level, in a science classroom where students construct their own understandings of science through answering their own questions in discussion with peers and teacher." In short, thanks to Emily's negotiations around equity, particularly in relation to special education status, Janet was able to continue the negotiation in the community with Julia to support the learning of students with disabilities. Summarized by Penny, the new negotiations of the community focused on "anti-racist teaching" and for Penny, these negotiations, "helped me to reflect on my own personal views and actions, but also helped me to view science education through a whole new lens." For Penny, she was focused on "Building a strong classroom community where students feel comfortable taking risks and feel seen as people." This is supported by Boaz who said, "Good teaching isn't just achieving standards and having good relationships with kids. It's accomplishing that within an anti-racist model, multiple ways of knowing and explaining what science actually is and applying it and the strategies used to learn about it to the real world and the future" (McCausland & McDonald, 2024, p. 19). What the negotiations around equity reveal is that while the community was working to enact a relational form of AST that decentered content knowledge and prioritized relationships of trust, the community took the negotiation around relationships and started to negotiate a more justice-centered notion of science teaching (e.g. McCausland & McDonald, 2024; 2025).

Discussion

In the findings above, we include a brief sample of our narrative to try to capture the shifts in a 15+ year research-practice partnership. Throughout the complete narrative, we argue the series of shifts in the professional vision of the community revolved around three major themes: 1) a shift from explaining ideas to students to eliciting students' ideas, 2) shifting from viewing teaching as a decontextual, mechanistic process to viewing teaching as fundamentally relational, and 3) shifting from viewing science teaching as neutral and objective to grappling with equity in schools and society. We argue these themes are an evolving shift of focus between intertwined problems without ceilings (Thompson et al., 2015). For us, the data suggests that negotiating professional vision in the community was an iterative process of negotiating knowledge objects through talk and practice that were evolving characterizations of these same three core dilemmas. The growth and development of the partnership shifted based on external and internal inputs to the community, both human and non-human, and while the framing of some negotiations were exchanged for others (e.g. AST for inquiry), the community continuously negotiated the same knowledge objects (science curriculum and pedagogy) in an attempt to improve practice.

Professional vision (Goodwin, 1994), when conceptualized in his original framing becomes a powerful analytical tool to help us understand these on-going community negotiations. Practices are not stable and standardized, but the result of highlighting and coding in context within the professional community. These negotiations do happen in the moment, but those moments also make up rich tapestries of negotiation occurring across long periods of time and multiple institutional and cultural contexts. Viewing teacher learning as something that is the result of large structures and policies or the result of planned professional learning activities misses the rich complexity of how those things interact with all of the other small moments and long histories that create teaching practices. This is not about fidelity to a curriculum or policy, but about reframing organizational context (Allen & Heredia, 2021) and opening up our notion of what teacher learning is and where and how it happens.

We also argue the broader science education infrastructure enhances but is not necessary for research-practice partnerships. The broader infrastructure of the science education community contributed to the negotiation of meaning and expedited the partnership's development. However, throughout the data we noticed that with the exception of 2009, where National Science Foundation funds acted as a catalyst for the partnership, many of the innovations and negotiations of the community outpaced the broader science education community. For example, while science education has increasingly had conversations about equity and justice, the partnership was critiquing AST before newer innovations emerged years later (see, Thompson et al., 2021; Leuhmann et al., 2024). While this may reflect the delay in academic publishing cycles, it indicates that funding and new academic language is not necessary for partnership building and sustainability (although it can help) and that the literature does not necessarily reflect the innovations happening in local communities and schools as important sources of advancing the field. Our data indicate that external funding and scholarly framing of knowledge objects are not necessarily needed for ongoing engagement, growth, and learning in partnerships.

In a time where funding is becoming increasingly scarce and science education (and education more broadly) is under threat in the United States, we argue science education should focus on forms of scaling that are "slow," but support deep and lasting change. By this we mean to focus on building relationships with our local communities and working collaboratively with those communities to engage in problems without ceilings. In fact, we argue science education could be taking lessons from community organizers and scholars who study social movements (for examples see, Curnow & Jurow, 2021; Staples, 2012; Uttamchandani, 2021) because relationship building can be "a method for achieving both individual and systems change" (Christens, 2010, p 894). It is the relational approaches to change and their on-going commitment to negotiation of knowledge objects in the partnership that drove innovation and a scale-up of those innovations from classrooms, to schools, to districts, and eventually to impacting statewide practice. The learning sciences is historically grounded in doing practical work in learning environments as part of approaches like co-design and design-based research; however, there has still been a reliance on distal forms of influence - short term professional development, curriculum distribution, and seeing preservice teachers as change agents. Our community indicates that for deep, locally meaningful, and lasting change we need to become the change we want to see in collaboration with our community partners.

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