

STEM Teacher Leader Collaborative: A Responsive Professional Learning Network With Radical Hope

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Abstract

Many elementary teachers in the United States receive little to no STEM-focused professional learning during an average school year. When elementary teachers do participate in professional learning opportunities focused solely on STEM teaching and learning, they are often positioned as novices in need of improvement or instruction rather than colearners and cocontributors to the learning community. In this article, I describe the STEM Teacher Leader Collaborative as one way to address current challenges in STEM-focused professional learning and as an infrastructure for responsive teacher learning. I highlight the STEM Teacher Leader Collaborative as a model of a responsive professional learning network with radical hope, describing its guiding principles and the meanings teachers make of their experience within the network.

Introduction

Those first few days of PD [professional development] weren't like normal PD. You didn't tell me what to think; you let me figure it out for myself. That's what made it so easy when I took it back to my classroom . . . , but it's more than just a PD, isn't it? It's all kinds of PD . . . and networking. I've met people through STEM TLC that I collaborate with all the time, even though we don't teach in the same school. STEM TLC is this group that offers PD and supports me . . . but it's also this community of people who are all working together on, like, this common goal.

—Kendall, Third-Grade Teacher

The STEM Teacher Leader Collaborative (STEM TLC) is a university–teacher partnership, a network designed to transform the landscape of science and engineering education in our local area. Its mission is to connect and support teachers within and across schools and school districts, redress issues of STEM inequity, and facilitate science and engineering professional learning opportunities. Founded with and for elementary teachers in the North Carolina Piedmont, STEM TLC is steadfastly responsive to teachers, values teachers as professionals, and recognizes that teachers have experiential and professional resources that we can and should leverage. Through a grassroots effort, what began as the partnership of two university faculty members and three classroom teachers has grown to a network of over 200 educators.

During an average school year, the majority of elementary teachers receive little to no STEM-focused professional learning (Banilower et al., 2018). When it is available, teachers often find professional learning structured using top-down approaches, organizing coherence around predefined content, and moving teachers toward externally defined goals. In these scenarios, teachers are positioned as implementers of practices (Lindvall & Ryve, 2019) rather than colearners and cocontributors who are equal partners in the learning community. To address these challenges, STEM TLC builds capacity and infrastructure for responsive teacher learning within and across schools and is designed with the following principles in mind.

1. *Responsive*: Recognizing, attending to, and building on teachers' realities, experiences, resources, and ideas to support professional learning (Watkins et al., 2020).
2. *Professional Learning Network*: A group of educators engaging in collaborative learning outside of their everyday community of practice that values the multiple perspectives of its members (Lieberman, 2000).
3. *Radical Hope*: A combination of aspiration and agency; the ability to imagine and anticipate future possibilities beyond those that are determined by current limitations (Gannon, 2020).

In this article, I describe STEM TLC's model of responsive professional learning, connect it to the existing literature on professional development, describe teachers' meanings of each principle, and illustrate how the principles wove seamlessly through one teacher's narrative of experience with STEM TLC. Though each principle is described separately, they function iteratively in practice, and the case study at the end of the article demonstrates their relational nature.

It should be noted that, at times, I take a first-person stance in this paper as "I" am the author and storyteller. However, the STEM TLC is a collaborative in the truest sense of the word. It is a collective network of educators, team members, and teacher leaders, coming together to support one another in changing the STEM landscape. Therefore, at other times a third-person stance is used as I am part of the "we" and the collective work accomplished within the STEM TLC.

A Responsive Professional Learning Network with Radical Hope

What do we mean when we say that STEM TLC is a responsive professional learning network with radical hope? We define each part of the model designation below.

Responsive

With its roots in responsive teaching, professional learning that is responsive is designed to be flexible so that it meets the needs of teachers, as those needs arise, and is tailored to teachers' social, instructional, and pedagogical goals (Anderson & Gallagher, 2019). Being

responsive to learners involves: (a) centering the substance of learners' ideas by attending to learner's sensemaking throughout experiences (Coffey et al., 2011; Jacobs et al., 2010); (b) exhibiting intellectual empathy by listening to, being present with, and understanding learners' thinking (Robertson et al., 2015); (c) recognizing connections within learners' ideas (Russ et al., 2009); and (d) taking up and intentionally pursuing the matter of learners' thinking, allowing the direction of instruction to emerge from the learners themselves (Jacobs et al., 2010; Russ et al., 2009).

Just as students' learning is supported by teachers' attending to and responding to their assets, ideas, and needs, professional learning can be responsive to teachers by seeking out and building on aspirations, experience, and assets. A responsive approach to teacher education and professional learning supports teachers to engage in and sustain their inquiry, both disciplinarily and in their own practice (Watkins et al., 2020). In a responsive professional learning setting, teachers' ideas and experiences serve as the terrain for learning, exploration, and inquiry. This terrain is cultivated by facilitators who foster productive interactions amongst participants and maintain flexibility in both thought and action. They anticipate, listen for, and adjust to teachers' ideas and tailor experiences to build on teachers' knowledge bases and experiences (Watkins et al., 2020). Responsive professional learning also takes into account teachers' contexts. STEM TLC was responsive to multiple chronologies, acknowledging the ways historical meanings of schooling and teaching bear down on teachers' practice, foregrounding teachers' goals and aspirations, and acknowledging teachers' day-to-day realities (e.g., professional loneliness, lack of time and resources, cultures of surveillance, deficit-based positioning by others, and celebration of compliance and status-quo practices [Mercier, 2020]).

Examples of STEM TLC Responsiveness

STEM TLC's responsiveness was the foundation and impetus of its creation and the design of professional learning opportunities. Holly, a third-grade teacher, said:

I just feel so alone in . . . [my attempts to include science]. It would be different if the other people in my grade or on my hallway wanted to talk about science. They don't even want to teach it. It's hard to teach this way, when you're the only one.

In response to Holly's sentiments, which were shared by many other teachers, we created a professional learning opportunity called Communities of Inquiry, ongoing professional learning communities in which teachers from different schools came together to discuss problems of practice and collaboratively plan science and engineering lessons to deepen their repertoires of experience to address the problems. Table 1 elaborates on the responsive nature of STEM TLC's opportunities beyond this one example.

Table 1*STEM Teacher Leader Collaborative (STEM TLC) Opportunities and Their Responsive Nature*

STEM TLC teachers said	STEM TLC responded with (year)	Description
"I'm ready to try something new to reach all of my students. I don't teach a lot of science, but I'm looking for something that will help me push it back into my classroom." (LG, Pre-SI Survey)	Introductory Summer Institute (2012, 2015, 2016, 2017, 2018, 2019)	A 3-day professional learning institute for elementary teachers centered on engineering instruction that intentionally focuses on engineering as a way to disrupt teachers' perceptions of traditional science instruction and surface equitable instructional practices for elementary science and engineering.
"Sometimes I feel like the unicorn. I'm the only one having the difficult conversations and really pushing science and engineering on my team. I really wish I weren't the unicorn. It's lonely being a unicorn." (WW, Post-SI Interview)	Community of Inquiry Groups (2018, 2019, 2020)	Small groups of four to five elementary teachers, clustered by grade level, meet twice a month and participate in a Lesson Study inspired professional learning community (Dotger, 2015; Thompson et al., 2019) focused on inquiry into teachers' STEM practice.
"How do I take everything that I know about engineering and use it to plan science? How do I take my science units beyond the textbook?" (SS, Post-SI Survey)	Advanced Summer Institute (2017, 2019)	A 3-day professional learning institute for elementary teachers who wanted to explore phenomenon-driven science and ambitious science teaching centering students' thinking and sensemaking.
"This is all so new and different, and I feel on my own out here." (KM, Teacher Reflection)	STEM TLC ² Webinars (2020)	A series of webinars, initially addressing socioemotional needs of teachers and reestablishing a sense of community and support, later transitioning to a series of "bite-sized" professional development webinars that focused on science instruction and student sensemaking for virtual teaching and learning.
"Right now, it's hard to teach STEM in elementary school. It's not always that way, but I feel like I'm in a funk. I just need to dig deep and find some new inspiration or recharge." (MK, Post-SI Interview)	STEMergizing Saturday (2019, 2022)	A 1-day STEM professional development opportunity to "reenergize STEM instruction." Teachers participated in design challenges, explored strategies for inquiry-based science, and participated in a Vexation-Venture activity (Settlage & Johnston, 2014) to connect with other STEM TLC teachers and brainstorm new ideas to infuse into their STEM instruction.
"I'm just really unsure of how to translate this into my classroom." (LW, Post-SI Survey)	In-School Support (2016, 2017, 2018, 2019, 2020, 2021)	STEM Coaches and members of the STEM TLC team, upon teacher request, coplan, coteach, advise, and model science and engineering pedagogical practices.
"Is there a chance to collaborate with other teachers? Because I'm the only one in my building." (AP, Focus Group)	Teacher Leader Summit (2016)	A 1-day professional learning opportunity bringing teachers actively involved in STEM TLC together to envision and establish the idea of the STEM TLC Teacher Leader—coconstructing definitions, expectations, and ideals.
"My experience with STEM TLC has meant so much to me. Help me have a voice in sharing that with others." (DM, Focus Group)	STEM TLC Teacher Leaders (2016, 2017, 2018, 2019, 2020, 2021)	Elementary teachers, closely associated with STEM TLC, who actively integrate science and engineering into their elementary curricula and work with STEM TLC in a variety of ways, including coplanning and cofacilitating professional learning opportunities, mentoring teachers outside of their schools, and presenting at conferences.
"I believe that integrating engineering units into my science block might be life changing for my students. But where do I get the resources to do that? We don't even have supplies for science." (CW, Post-SI Survey)	STEM TLC Lending Library (2016, 2017, 2018, 2019, 2020, 2021)	A curated collection of STEM materials available for teacher use—including engineering kits, science kits, children's literature, consumable and nonconsumable supplies, resources for science lessons and units aligned with state science standards, materials for making activities, etc.
"I want to help shape the future of the network!" (SP, Interest Survey)	STEM TLC Leadership Lab (2017, 2021)	A 1-day community collaborator meeting and community charette model in which various stakeholders coconstruct the vision and goals with the STEM TLC founding team.

Note. Data is comprised of quotes from teachers participating with STEM TLC and were collected through pre- and post-professional-learning-opportunity surveys, questionnaires, and interviews.

Professional Learning Network

Professional learning involves the tandem nature of thinking and acting in relation to one's context and against the backdrop of one's goals, values, understandings, beliefs, and commitments (Nolan & Molla, 2018). Professional learning is typically interactive, sustained, and relevant to teachers. High-quality professional learning is relevant, active, job-embedded, collaborative, sustained, and reflective (Darling-Hammond et al., 2017).

The most effective professional learning engages teams of teachers who, together, focus on the needs of their students and problems of practice in their classrooms. They learn and solve problems together (Borko, 2004; Horn & Little, 2010). What happens, then, when collaborative colleagues are absent from the professional learning landscape? How do you build the community needed to support teachers in professional learning? Our solution was to create, nurture, and sustain a professional learning network, a model of professional learning and support rarely available to elementary teachers.

STEM TLC is not an encapsulated professional learning experience or even a series of connected opportunities. Rather, it is an infrastructure and network with many ways to reach out to, connect with, and respond to teachers in our area. We use the word *network* in the sense of an encompassing learning community that is organized around the experiences, interests, and aspirations of the participants and the coconstruction of agendas sensitive to teachers' individual and collective development as elementary educators who teach science (Lieberman, 2000).

STEM TLC shares key characteristics with learning networks, as discussed in the literature. One such characteristic is how networks begin. Learning networks begin small and tentatively and grow with the needs, desires, and vision of their members and leaders. Teacher networks pay particular attention to the conditions and purposes that bring people together, emphasizing the building of relationships through collaboration in support of work that advances the goals of the network. STEM TLC also reflects the characteristics of a learning network: It enables teachers to participate in creating and sustaining a learning community that advances professional identity, passion, and learning. Collaborative relationships help build trust within the group, which is essential to the development of new ideas (Lieberman, 2000). These ideas, in turn, help build network interest and participation, even as ideas and relationships continue to develop and transform. This cycle of a learning network energizes teachers and commits them to each other as well as to the larger ideals of the network.

Examples of STEM TLC as a Professional Learning Network

There are myriad ways that STEM TLC embodies a professional learning network. For example, teachers who have participated in STEM TLC return to participate in new opportunities, act as leaders and facilitators, and continue to collaborate with one another outside of the program. We also provide opportunities for educators to return and enact leadership roles to mentor fellow teachers. STEM TLC leans heavily on our Teacher Leaders, teachers who are actively engaged with STEM TLC and who frequently integrate science and engineering into their instruction. These Teacher Leaders, upon request, volunteer to help facilitate professional learning opportunities and mentor small groups of teachers. Kendall, a third-grade teacher and Teacher Leader, explained:

When I was asked to be a Teacher Leader, it was both nerve-wracking and exciting. I didn't know if I was ready for that kind of leadership, but I remembered how important it was for me to work with a Teacher Leader [when I was a participant]. It's like this essential element of STEM TLC, that we learn from each other, from other teachers, with Teacher Leaders. That community that you get from that, it's part of what makes the STEM TLC experience special.

Radical Hope

We see hope through its connection to possibility. Edgoose (2009) said, "Hope is the belief in the possibility of a better future, and thus our sense that our efforts to 'make a difference' might be worthwhile" (p. 106). STEM TLC is a professional learning network with radical hope, which is how we maintain optimism even when difficulties seem unmanageable (Lear, 2006; see also Edgoose, 2009; Gannon, 2020).

We draw our understanding of radical hope from Gannon (2020), who referred to *radical hope* as a praxis of agency and aspiration in teaching when he said:

The very acts of trying to teach well, of adopting a critically reflective practice to improve our teaching and our students' learning, are *radical*, in that word's literal sense: they are endeavors aimed at fundamental, root-level transformation. And they are acts of *hope* because they imagine that process of transformation as one in which a better future takes shape out of our students' critical refusal to abide the limitations of the present (p. 5).

This speaks to STEM TLC and the teachers within our network, as elementary teachers in the United States, who imagine similar processes of transformation for their students while contending with daily limitations. Elementary teachers feel pressures bear down on them from both inside and outside the classroom as they face a present fraught with challenges to their profession and professional judgment and an increasingly uncertain future for their science and engineering practice. We ground the STEM TLC professional learning network in radical hope with the hope of allowing for a sense of agency to change things in keeping with a vision of a better future.

Radical hope is not so much something one has but something one practices. It demands flexibility, emotion, openness, creativity, and forward-thinking imagination. It becomes a set of lenses through which STEM TLC positions communities, teachers, schools, and opportunities for professional learning (Gannon, 2020). Grounding a responsive professional learning network in radical hope is about creating spaces for teachers to collaborate, learn, design, imagine, and take risks. It means cocreating with teachers forward-thinking and actionable next steps for elementary teachers' science and engineering practice without succumbing to those pressures, which we acknowledge as real and consequential, that bear down on teachers' practice.

Examples of Radical Hope in STEM TLC

Radical hope is also a nod to the affective dimensions that we often lose when professional learning is seen as transactional rather than taking a humanistic approach. It is a deliberate way of knowing and being with each other in a learning community. For example, at the onset of COVID-19, teachers suddenly found themselves teaching remotely, feeling isolated and disconnected from colleagues and teammates. A new opportunity, STEM TLC², began a series of 40-minute biweekly webinars that were, at their onset, a place for teachers to reconnect, network, find and give support, and experience the community that they suddenly found missing. As remote teaching continued, the STEM TLC² webinars transitioned into brief, easy-to-access professional learning opportunities. No matter the format, the beginning of each biweekly session was dedicated to checking in with one another, encouragement, and hope. This affective dimension, addressing the whole educator and not just their practice, grounded these webinars in radical hope.

Our interpretation of radical hope is not meant to apply undue pressure on teachers to enact toxic optimism or positivity (David, 2016). Instead, our version of radical hope harnesses the power of groups, a form of collective agency to envision and make more just realities a possibility. In this way, teachers acting together can be a force for changing the system.

Contextualizing STEM TLC as a Responsive Professional Learning Network with Radical Hope

STEM TLC's guiding principles are difficult to isolate as individual, standalone tenets because they work in relational ways. Additionally, it may be difficult to fully visualize STEM TLC as a model of a professional learning network with radical hope without a better picture of the network. In the following sections, I hope to provide context, background, and meaning to STEM TLC.

STEM TLC began in 2012 as a small group of two university faculty members and three classroom teachers committed to exploring integration possibilities for engineering into elementary curricula. That group of five educators joined forces with three more classroom teachers to form STEM TLC's first professional learning experience, resembling what we

now call our Introductory Institute. There they explored the engineering design process and created avenues to fit engineering into day-to-day instruction. From there, STEM TLC has grown as a network to now include over 200 educators. They arrive through a variety of methods and stay for a variety of reasons—some teachers dip in and out of professional learning opportunities, whereas others engage in everything we offer. Teachers come to be involved with STEM TLC mainly through word of mouth and recruitment by peers and colleagues. We strive to establish a professional network for teachers and a true collaborative; thus, involvement with STEM TLC is not mandated by districts or administrators.

The STEM TLC team works to be ever-responsive to teachers. Over the past years, STEM TLC has offered teachers in the network a variety of opportunities. Even the Introductory Institute has changed and morphed in response to what teachers bring to professional learning and the needs they communicate. Table 1 shows not only the many opportunities offered to teachers through STEM TLC but also a glimpse into the responsive nature of each.

Year in the Life of STEM TLC

As a professional learning network, STEM TLC is more than just a singular, standalone professional learning opportunity. Additionally, STEM TLC's professional learning opportunities are always in flux. With the goal of being responsive to teachers associated with the network and present, it is nearly impossible to describe a typical STEM TLC event or professional learning opportunity. Instead, in this section, I describe the 2018–2019 academic year in the life of STEM TLC in hopes that the reader might be able to better visualize and understand STEM TLC as a responsive professional learning network.

The 2018–2019 academic year began in July for STEM TLC with the Advanced Summer Institute, a 3-day opportunity led by STEM TLC team members and teacher leaders. Fifteen teachers experienced a phenomenon-driven learning experience from the perspective of learners, unpacked two additional lessons together as a group, and then explored content storylines in small, grade-level-specific groups. One week later, in late July and early August, STEM TLC welcomed 42 educators to the Introductory Summer Institute. Over the course of 3 days, the Introductory Summer Institute intentionally used engineering as its driving mechanism to provide teachers with unique learning opportunities and nudge them out of comfortable teacher-led strategies and towards instruction that emphasizes student talk, meaning-making, and collaboration. The Introductory Institute was coplanned and cofacilitated with STEM TLC Teacher leaders—classroom teachers who were actively involved in STEM TLC opportunities and regularly worked to integrate STEM into their classrooms.

As the school year began, STEM TLC shifted to supporting teachers with in-school support and coaching. The STEM TLC newsletter was emailed to the network monthly, which included vignettes of STEM in teachers' classrooms, a featured children's book with an accompanying lesson plan, news about upcoming events, and reminders about the STEM TLC Lending Library—a curated collection of materials and resources for teachers' STEM instruction (e.g., engineering kits, science kits, children's literature, physical materials, and resources). Over the 2018–2019 academic year, 34 teachers utilized the STEM TLC Lending Library by requesting resources through the STEM TLC website and having resources delivered to their classrooms by a member of the STEM TLC team.

Teachers also took advantage of STEM TLC's STEM Coaching and support. Teachers requested STEM Coaching, the duration and format of which varied based on teachers' needs and aspirations. For example, this could be a member of the STEM TLC team modeling a lesson in the classroom, coplanning science or engineering units, or serving as an extra set of hands and an additional facilitator of learning. As January approached, there was a sense that teachers wanted to reconnect with others in the STEM TLC community and were hungry for additional STEM ideas. STEM TLC hosted STEMergizing Saturday, which brought together over 80 teachers from across the state. STEMergizing Saturday began with an engineering design challenge and discussion of integration possibilities, continued with learning centered on children's sensemaking and wondering, and concluded with Vexation and Venture conversations in which small groups of teachers engaged in energetic discussions workshopping persistent challenges to STEM in their classrooms (Settlage & Johnston, 2014).

Following STEMergizing Saturday, STEM TLC launched Community of Inquiry (COI) groups. COI groups were small collaborations of classroom teachers grouped by grade level and focused on collaboratively planning learning experiences for their classrooms and inquiry into their own practice. Inspired by Lesson Study (Dotger, 2015), the four COI groups, each with four to five members, met twice a month for the remainder of the school year, one meeting to plan a STEM lesson and the other at a teacher's school to observe, reflect on, and revise that same STEM lesson.

The remainder of the 2018–2019 academic year was filled with more STEM Coaching, resource deliveries, COI group collaborations, and presentations at local conferences. STEM TLC presented at conferences to increase the visibility of the network, promote its model, and advocate for elementary teachers and STEM education. Teacher Leaders were always present for these conference presentations, empowering teachers as leaders and centering the voices and experiences of classroom teachers.

The STEM TLC Experience

The STEM TLC model of a professional learning network attracts all kinds of educators—first-year teachers, veteran teachers, specialists, instructional coaches, administrators, and special education teachers—leading us to ask what meanings teachers make of STEM TLC opportunities. Next, I share Marlene’s experience. Marlene’s story is a compilation of four interviews that took place over 2 years. In these interviews, Marlene reflected on her experience with STEM TLC from 2018 to 2020. I chose to share Marlene’s experience because we think it demonstrates the relational way the three principles (responsiveness, professional learning network, and radical hope) resonate with her making meaning of and learning within STEM TLC. As you read her story, note the style conventions: I bolded references to **responsiveness**, italicized mentions of *professional learning*, and underlined statements that touched on radical hope.

The STEM TLC Experience in Marlene’s Words

Marlene, a veteran fifth-grade teacher for 16 years and a middle-school teacher for 3 years before that, came to her first STEM TLC event, the 2018 Introductory Summer Institute, more than 2 years ago.

Has it only been 2 years? Wow. I sought out STEM TLC because I was just in a rut, so to speak. It really goes back to a young lady that I taught It was evident that I was not reaching her. I had asked her to do a lot of changing, but I think it came to a point where I realized that I needed to do a lot of changing too I began to question, you know, maybe it’s the way I was teaching So, I looked around for something that could help me with that change, and I found you [STEM TLC].

Marlene connected with STEM TLC in much the same way other teachers did—through word of mouth. STEM TLC circumvents the top-down norm in which administrators decide who attends what professional development opportunities. Open to all educators, STEM TLC grows as teachers share their experiences with colleagues.

You know it’s hard to remember who first told me about STEM TLC. It’s like *I kept hearing about it from all these different people*. I know that Ms. Ramos came to me and said something like, “I just heard about this amazing group from a friend at the gym. I’m going to check it out; you should too.” And then I know that [Instructional Coach] came to me and said that something I said in a meeting made her think of me when she heard about STEM TLC. I thought, well, if these *people are a part of this*, then it must be worth it.

Marlene’s first experience with STEM TLC was the Introductory Summer Institute, a 3-day professional learning institute focused on integrating engineering instruction into elementary classrooms.

Yeah. That first PD was life changing. I know you think that's an exaggeration, but it was. I've gone to plenty [of] other professional developments. I've gotten things out of some and nothing out of others. And even when I've been getting things from PD, it wasn't always applicable. I couldn't **apply it in my classroom**. That was one thing about that first PD. I kept watching all those *other teachers in my group* when we learned about engineering together, and I kept picturing my students. I could see how this would help each and every one of them. And we didn't just sit down and hear about what we should do in our classrooms. We got to explore and try it out and work with other people. That's when **I knew it would be meaningful**. You know, you always go to professional development to learn things, but for it to be meaningful, you have to be able to put things into practice.

Marlene returned to her classroom in the fall with a sense of motivation and optimism. She explained, "I was so excited to start the year. I felt like I had all these new ideas for teaching science and engineering. This year was going to be different." As Marlene began the school year, she felt that motivation wane.

You know, after that summer, I had a new way of seeing STEM for my classroom. I just didn't know if I'd be able to do it. I mean, how was it going to fit into my classroom? I was so different than the way we usually taught. How was this going to work with the kids? Suddenly, I started to doubt myself again. I just didn't think this was going to work after all.

When the STEM TLC newsletter arrived in her inbox a month or two later, Marlene noticed a reminder to teachers that they had access to the STEM TLC Lending Library. This library housed engineering kits, science kits, science resources, class sets of consumable and nonconsumable materials, STEM-focused children's literature, a lesson plan repository, and even a box of rocks.

I was really struggling to figure out this engineering thing and fit it into my classroom. But I got that email, and I decided this wasn't ever going to happen unless I tried, **so I checked out a [engineering] kit**. Carina [STEM TLC team member] delivered it right to my classroom. And then this is where I started kind of blending it in here and there. I tried it in little pieces. And then *Carina came back and coached me* through the knee brace kit. *We taught it together*. That was a real turning point. Everything changed after that. I could easily **see how it fit in my classroom**, and I could see it working.

You know people always say that quote from Field of Dreams, “if you build it, they will come.” But what happens if you can’t build it? STEM TLC realizes that classroom teachers don’t have everything they need to teach this way. Not having what you need not only hinders you from doing it, but it hinders you from thinking that it can be done that way in the first place. The willingness of **STEM TLC to provide these resources** that we lack in our classrooms is key. It’s also *the support that I get with it*. I’ve come to appreciate what I can get from STEM TLC but also look at what I can do with the limited resources I do have. It’s like it changes the lens that I look at things with. I’m no longer looking at, more or less, the glass half empty but half full.

A few months later, Marlene received an invitation to STEMergizing Saturday, hand-delivered to her by a STEM TLC team member. Marlene was surprised by this invitation, “It meant so much that you would take time to invite me to something in person. *I was reminded of our connection.*”

STEMergizing Saturday, just like STEM TLC, was inspiring and motivating. I think it was the presentation. It was the coming together as teachers and acknowledging that there were some things that we were lacking, that we didn’t know so well, or that we’ve lost our motivation for, but being open to learn new things. *It was like a big reunion in a way. There were people I hadn’t seen in a while, people I see every week, and people I’ve never met.* But I know that if you’re at STEM TLC that you’re a kindred spirit. *It’s like this big team, big family,* that comes together and laughs and learns together . . . , **and it seems to speak to what teachers are saying, about themselves, their schools, what’s going on in education.**

That STEMergizing Saturday, was a real turning point for me,” Marlene explained. “It really did energize me. I wanted to do so much more with the STEM in my classroom.” However, there was a speedbump in Marlene’s new energized vision of science and engineering instruction—a feeling of isolation. The only other teachers who shared similar commitments to STEM instruction were many grade levels below her and many hallways away.

I felt like I was the only person around teaching this way. The only one who wanted to. We kept getting pressure from [Administrator] and the district to only teach science this one way. And other teachers on my team, even in fourth grade, weren’t interested in trying something new. I wanted a team. I wanted a team to plan with, to brainstorm with, to try new things with. You know, I shared that with my group [Critical Friends Group] at STEMergizing Saturday. It turned out that *some of us connected over that.*

In fact, we heard expressions of professional loneliness from many educators both at STEMergizing Saturday and in the months leading up to it. Innovative elementary teachers who creatively push boundaries to teach STEM in their classrooms often report feeling

marginalized and isolated, and teachers connected with STEM TLC were no different. A few months following STEMerGizing Saturday, Marlene joined a STEM TLC Community of Inquiry (COI) group with other fifth-grade teachers.

I wanted that **connection** because I felt so alone. I felt that I needed somebody to plan with, somebody to throw ideas out at, even to get ideas from. It turned out that we all wanted the same thing. It was like, *they became my teammates*. Our COI group was more than just us coming together for PD; *we're this committed community*. You're not afraid to make mistakes or step out of your comfort zone because you know that *everyone supports you*.

Being a part of the [COI] group was another turning point. Joining this group **gave me a lot of guidance** and gave me insight on some other resources and also gave me some perspective from other teachers who were actually interested in teaching science. And being able to see our ideas and observe our lesson in someone's classroom, like when we focused on student talk and science ideas, seeing it in Abigail's classroom made me sit back and think about how I could make that same thing happen in my classroom.

Marlene's involvement with STEM TLC's COI groups continued well into the next school year. In fact, the entire group of fifth-grade teachers returned to their COI group for the next two semesters and invited new members who also became devoted participants.

I had a student tell me once that I taught science just like I was teaching middle school language arts. Teaching science felt the same as teaching reading. And he was right. We would take out a book and read it and answer the questions. That's all I did. We never did experiments. They [students] may have worked in groups, but I certainly didn't focus on the discussions they were having. But at least they were doing something. But with the COI group and then the Advanced Summer Institute, the fact that *we came together and talked about what good science teaching should look like and we talked about the lessons*, just being a part of this made me realize that this kind of science, good science, was something I could do. I had these new ideas to try out in my classroom, like not putting the vocabulary first, using phenomena, and stuff. To see those new possibilities for my classroom in action and to hear about other teachers doing that, it gave me the confidence to change things in my classroom.

Before this [STEM TLC involvement], not only did I not teach science well, [but] I didn't like science. It was never my forte, so to speak. So when I gained an understanding of it and found joy in it, it was easier to teach it. And for me, **that's what this group does for me**.

Marlene delivered her joy, understanding, and experience to more than just her students. As a Teacher Leader, Marlene presented alongside STEM TLC team members at conferences, coplanned and cofacilitated professional learning, and shared her unique expertise with teachers during STEM TLC² Webinars, a series of bite-sized professional development webinars bringing educators together during COVID.

“There’s just something different about STEM TLC. **Everything is applicable; it’s purposeful for me,**” Marlene explained. Marlene likes to credit STEM TLC with “changing her life.” In Marlene’s short time with STEM TLC, she has grown and shifted in her perspective and practice.

Conclusion

The success of STEM TLC has grown and continued over the years. What began as a small group of passionate, like-minded teachers and university faculty members grew into a network of over 200 elementary educators across our region. There is a reason that teachers are drawn to STEM TLC and keep returning. Elementary teachers rarely have opportunities for professional development devoted to STEM. STEM TLC not only provides STEM-focused professional learning opportunities but also addresses the many other needs and aspirations of educators. With the infrastructure created through STEM TLC, we collaborate with, learn with, and support elementary teachers in urban and urban emergent schools — meeting teachers where they are, acknowledging the realities they work in, celebrating them as professionals, and working together to realize a better future for STEM teaching and learning.

I am not arguing that current teacher professional learning models are failing elementary teachers. Instead, I am highlighting STEM TLC as a model of what infrastructure for teacher learning could be in these increasingly fraught and de-professionalizing times for elementary teachers, the kind of professional learning that elementary teachers often seek. A responsive professional learning network with radical hope (Gannon, 2020): (1) embodies an approach to teacher learning that sees content knowledge, pedagogical knowledge, and educators as in the process of becoming; (2) acknowledges and values teachers as experienced, capable professionals, positioning them as active agents in their professional learning; (3) occurs in a community that is hyper-aware of teachers’ realities and empowers teachers by creating equitable and accessible learning spaces that address those realities; (4) cultivates and sustains learning environments and opportunities that allow educators to take risks in spaces that foster empowerment, tenacity, and growth; and (5) promotes a vision of community in which teachers are positioned as co-contributors and co-learners who inform and learn from each other. In this way, STEM TLC serves as a model of the kind of professional learning, support, and community that elementary teachers both seek and deserve.

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