“It Was a Really Amazing Sandbox”:

The Collaborative Creation of an Intergenerational Teacher Education Community

Suzanne Pratt

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Abstract

"It Was a Really Amazing Sandbox":

Nurturing Spaces that Foster Collaborative Teacher Learning

Suzanne Pratt

This longitudinal, qualitative case study explores the creation and evolution of an *intergenerational teacher education community* over the course of five years. The group at the center of this study is the Citizen Scientist Curriculum Team, a collective made up of mostly teachers who came to the work offering a range of expertise in a variety of areas and varying degrees of teaching experience. Other members of the team included a teacher educator (myself) and a high school (eventually undergraduate) student. The community was not intentionally created and did not appear one day fully formed. Rather, it emerged out of a series of smaller experiences and once established, continued to evolve over the course of time. This study explores the development of the community as a teacher learning space that grew and changed over time. In investigating this community, this study aims to better understand the intersection of terms—*intergenerational teacher education community*—as they are used to provide a framework for identifying and understanding the implications of what happens in teacher learning spaces that intentionally attend opportunities for teacher learning through collaboration and intergenerational exchange. When membership in a teacher learning community is deliberately positioned across a continuum, it encourages the development of mindsets that honor the contributions and perspectives of individuals at varying stages of experience. Rather than dictating answers, teachers need spaces to explore these ideas as they are supported in asking questions, seeking insights, experimenting with instruction, and engaging in critical

reflection. Intergenerational teacher education communities specifically address the intentionality of voice, representation, and experience in collaborative professional spaces while also incorporating opportunities to expand membership in ways that enhance perspectives, purposes, or priorities in relation to teaching and learning.

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Acknowledgements

A friend of mine once jokingly referred to my dissertation as my own personal *odyssey* and then went on to compare elements of my experience to episodes throughout Odysseus' adventure. While I rolled my eyes at the time, those observations turned out to not be so far from the truth. This work has taken basically the same amount of time as Odysseus' journey, has included a host of supportive fellow adventurers, and has been a catalyst for my own transformation (hopefully for the better).

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Dedication

To all the educators who set aside "can't" and just "did,"

even when others said it couldn't be done.

And to my Grandma Pratt and Elizabeth, both who encouraged and inspired me on this journey

but weren't here to see it come to its end.

Introduction

On a sunny July morning, a group of high school students, teachers (pre-service and in-service), and undergraduate interns gather in a shady corner of a local New York City Park. Congregating around a cluster of picnic tables located across from a small pond, the group is in the midst of wrapping up three-weeks of intensive learning about the health of the local ecosystem. Teachers from four local high schools have been coming together as the Citizen Scientist Curriculum Team to design, implement, and refine this learning experience for more than five years.

On this morning, Michael and Alex, two original members of the Citizen Scientist Curriculum Team stand on a small incline that offers a slightly elevated view of the goings-on of the day. They watch as approximately forty students, divided into four "learning pods," prepare to present findings from the data about the health of this and three other local water bodies to educators, family members, members of a parks alliance newly partnered with the group, and the community as a whole. This year's data is especially geared toward better understanding the eutrophication problem that is happening in the pond that stands just a few steps from where presentations are being finalized. Through the years, a various opportunities have come to share data with several local partners who have offered insight and expertise for preserving the local environment. However, this is the first time that the actions of the group are connected to a specific request for help from the local community.

As they watch, Alex and Michael reflect on how far this work has come from when they first participated in forming the Citizen Scientist Curriculum Team. Alex offers, "[Y]ou know, I think, in looking at it now, a few years later, as new people have taken leadership roles…this summer I had a real chance to kind of step back and watch where the program has gone." In

these five years, the Citizen Scientist Curriculum Team has evolved from a hastily formed group helping to design a science-focused workshop where pre-service teachers can spend a few days watching students engage in experiential learning to what members of the team describe as, "this really amazing sandbox," "[a space for] teacher experimentation," "a space [where]…the walls are down…[where] you have the opportunity to support each other," and "an outlet where I felt like I could do the type of teaching and learning that I was hoping to."

Shared participation in the Citizen Scientist Curriculum Team space has led to the development of student learning experiences that extend beyond anything that any one team member could create and organize alone. For example, this year, for the first time, the students coming together today represent participants of two different curriculums: One group of students has spent the last three weeks participating in the Citizen Scientist program that has grown and changed so much over the years. Students have spent the last three weeks collecting and analyzing three sets of data at this park and comparing their findings to data they've collected at other locations in the city. The second group of students who will be presenting are part of the Digital Citizens program, that is in it's first in-person pilot year. Students in this group have spent the last three weeks using elements of engineering and computer programming to design and develop potential technology-based interventions that address issues of environmental justice that are informed by data that was shared by Citizen Scientist students.

The Citizen Scientists have been using the presentation venue—a cluster of picnic benches in the park—as a homebase for this iteration of the program and they busily work, completing final touches on the posters they have designed. The Digital Citizens, whose homebase is a classroom at the college located a few blocks away, will soon be walking down to join in on the work. There is a lot of watching going on right now as members of the Citizen

Scientist Curriculum Team take a step back to observe the busyness of the moment and give students the space they need to finish their work. Pre-service teachers and undergraduate interns are busy acting as preparatory audience members so students can practice sharing their presentation remarks to a wider audience. Alex concludes:

> *I did a lot of watching this summer and really seeing where it's gone: The development of the groupings and the pods and you can see that language development is happening, you can see that solution and—you know, activism is happening. All those things that we always wanted. That it's happening… It just kind of got there. Because everything that we preached and fought for somehow got embedded in there along the way. Seeing it now was just like—I don't know…it was just like—it was watching something that you've spent so much time thinking about just become everything that you would have wanted it to be.*

This anecdotal moment takes place inside a wider context and system made up of numerous tensions and challenges faced daily by teachers. Policy makers, the media, and even other educators are not always complimentary of the work that teachers do. Many have opinions about what teachers *ought* to be achieving and are all too willing to offer a perspective. However, these same people are often far less interested in doing the work of listening, observing, and working to foster opportunities to refine practice in this complex and often underappreciated profession. At the same time, as pressures mount and decisions are made that encourage an orientation toward teaching that is increasingly de-professionalized, teachers struggle to maintain morale. In this context, even the best teachers feel the pressure of a waning margin for error as they attempt to create effective learning spaces for their students.

Every day, teachers fend off these daunting, demoralizing, and frustrating forces. This is the story of one group's attempt to push back by making a space meant for reimagining the possibilities of learning—learning for the group, other teachers, and those wishing to be teachers—with an eye toward transforming the experiences of schooling for students. By exploring the group's process of growth and change over time, I use this story as a case to interrogate and better understand the nature of spaces where teachers are intentionally and

actively engaged in the endeavor of fostering their own learning—when, where, and how does this happen? What does it look like over a sustained period? In taking up this idea, I've come to name this kind of space an *intergenerational teacher education community*. In using this term, I attempt to capture a complex community of teachers representing varying levels of teaching experience who have come together to engage in collaborative learning and support of each other. In the case of this story, I call this particular intergenerational teacher education community the Citizen Scientist Curriculum Team.

One member of the Citizen Scientist Curriculum Team, Alex, described its intent by saying, "We wanted to be brave. We wanted to provide opportunities for students that they never had before, that *we* never had before." What is brave about the work that this group is doing? This question might be best considered through a lens that juxtaposes forces that members of the group were pushing against on one side and working toward on the other. Another member of the team, Torben, offers an illustration by reflecting on the tensions he experienced between filling his role as a teacher and having institutional support to meet student's immediate learning needs:

> I have a hard time understanding somebody's motives when I'm presented with an 11th grader who can't yet read, and I'm staying after school with them reading picture books with them and I have an administrator come in and tell me that I just need to pass this kid. That doesn't feel like that's right. That's not. I feel like my job as a teacher should be to make sure that kid learns…. Kids aren't numbers, they're people and you can be majorly screwing up somebody's life, you know, and future prospects. And that person trusts you, and that person puts their future partially into your hands and you have to help them as best as you can….That to me was the hardest. It didn't make any sense. It was just bizarre. That did not feel like doing my job.

Versions of this story where, for various reasons, teachers feel their efforts dampened or unsupported can be common, especially for teachers who are working to develop a professional network that aligns with their own sensibilities of their role as a teacher. For example, Torben's conception of his role as a teacher did not align with his experience of how both teachers and

students were being treated in the school where he worked. Other members of the school community discouraged his courage to rethink the learning needs of students in his classes as he attempted to support the learning of a human being who has put "their future partially in your hands" rather than moving them along to be someone else's problem. This tension is one that was shared by every member of the Citizen Scientist Curriculum Team to varying degrees and that led to situations where teachers said things similar to Torben's expressions of "This doesn't feel right," and this tension with administrative expectations that I'm feeling right now "does not feel like doing my job." In this case, these feelings sometimes acted as a stagnating barrier, leading teachers to feel isolated in their practice. On the surface, the notion that teachers have a general desire to exist in encouraging spaces where they are enhancing their practice to "provide opportunities for students that they never had before, that we never had before" may not seem particularly revolutionary. However, acting on that desire, pushing past disheartening and demoralizing experiences, and using those to fuel a process of creation and improvement is exceedingly brave because it is in that process of creation that we open ourselves to the vulnerability, unpredictability, and potential failure in deep learning—in this case, deep learning about teaching.

The Citizen Scientist Curriculum Team offers an illustration of a group of people, mostly teachers, who came together to create a space for grappling with the complexities of learning, teaching, planning, imagining, and creating within a tightly integrated community. In this group, all members had different levels of experience and varying backgrounds of expertise. Each also had something of value to contribute. Over the course of time, each member had opportunities to voice and act on ideas while also experiencing times to pause, listen, and learn from others in the group. Despite—or perhaps because of—their diverse professional needs and career trajectories,

each member gave and took something valuable from the exchange. Given the ambitious and time-consuming nature of the project associated with the community, the outcomes and benefits had to be seen by each member as personally worthwhile or none would have chosen to make the effort to sit around the table. In this case, what precisely came from these exchanges and how did they impact the people who were part of them—from the perspective of the group and, also, individually?

This story is about figuring out how to better understand the dynamics and impact of an intergenerational teacher education community that has been co-constructed by its members and built to be a brave space. It is about educators working toward a shared goal of enhancing learning and enacting teaching to the best of their ability, despite the challenges that they faced. Admittedly, it is a story that might sometimes seem overly optimistic, but in a world where teachers are surrounded by forces that say it couldn't be done, it stands to reason that the sustainability of the group would call for an extra helping of hope to maintain the energy needed to keep on trying.

My approach to this project is from a multi-lensed perspective. I conceived of and enacted this study as a young researcher who was attempting to approximate the practice of research in ways that aligned with accepted methodology as well as my own sensibility. In doing this, I approached this study with particular concern about how research participants are invited into, participate in, and are represented in research. I was concerned about the difference between speaking *for*, *about,* or *with* someone in my research. It was because of this that I approached this study using a community-based qualitative research framework.

A second lens that informed the development of this study was my own membership in the Citizen Scientist Curriculum Team. Too often, researchers enter spaces and build

relationships with members of those communities that are designed only for the purpose of completing a research project. Once complete, the researcher leaves without much thought to the consequence of their arrival or departure (Johnson, 2017). In choosing to situate my study in the Citizen Scientist Curriculum Team, my hope was that this work would have the potential to act as a contribution to the group and a springboard for subsequent co-authored projects (this project was my dissertation, which eliminated the possibility of co-authorship) that could be used to further elevate the work of the group.

A third lens informing this work was that of my role as a teacher educator. In this role, I continue to see myself as a student of learning and of learning to teach. I am always looking for opportunities to better understand teachers' experiences and learn more about how others approach their own learning—and how that informs their teaching practice. My reflections on my own work with pre-service and in-service teachers is motivated by an attempt to better understand how we are all grappling with the realities and challenges of our experiences while seeking to enact strong teaching practice that positively supports students. This study has helped me to better consider what it looks like for teachers to support each other in an endeavor to maintain vision and vigor for the work we do, enthusiastically collaborate in ambitious experimentation of our practice, and share common commitments for engaging in teaching that is thoughtful, inclusive, and socially just.

In setting the stage for this study, I describe the origins of the Citizen Scientist Curriculum Team and briefly introduce the larger community that acts as a central hub for the group, a teacher preparation program that I will call the "residency program." The Citizen Scientist Curriculum Team and the wider community associated with the residency program are situated in a broader context where tensions, challenges, and assumptions inform ideas and

actions related to teacher learning and development in relation to two polars: one that argues for little if any change in ways that we approach teacher learning, clinging to the traditions of the past with a "persistent resistance to change in teacher education that keeps the field in a reactive mode" (Ladson-Billings, 2001, p. viii); and another that argues for complete reform, casting aside years of experience and research in ways that may lead to a dismantling of teacher preparation as it exists today toward a system that "differ[s] dramatically in its governance, structure, content and processes, moving away from its current location alongside legal, medical, and other professional preparation that pairs academic degrees with professional training" (Zeichner, 2016, p.3). For me, options on either side of this argument seem bleak at best and fail to acknowledge potential innovation that honors and expands the work of educators in the field while also recognizing opportunities for and a commitment to interrogating current practice with the intention of transformative development (Ellis & McNicholl, 2015). The idea of *transformation* can seem quite lofty and perhaps even a bit arrogant. Using the term too easily can also present dangers as the pressures for positive innovation have the potential to tempt us into using it so often that *every* practice comes to be named transformative—much like the word *progressive,* that has been used to "encompass such a broad range, not just of different, but of contradictory, ideas on education" (Kliebard, 2004, p.xviii) it has ultimately come to be an empty promise. If we are seeking to truly transform ways that we think about teacher learning and development, we must be wary of this as we closely and critically interrogate whether our actions and efforts truly have potential to inspire positive change.

For this study, asking, "*Does this have the potential to transform?"* is an important consideration because I *am* unabashedly attempting to both interrogate assumptions and expand ideas of how we think about, engage in, and enact opportunities of teacher learning in ways that

meet the criteria of transformation. Do practices such as those developed by the Citizen Scientist Curriculum Team indicate movement toward transformation? Maybe… maybe not… but in working to understand the evolution of our group *and* considering how we might apply those lessons in ways that contribute to the transformation of teacher learning, we are at least working to move actively in that direction

Chapter 1: Defining an Intergenerational Teacher Education Community

In the past twenty years, teacher quality has been emphasized and reemphasized as the most influential factor in ensuring high-quality opportunities of learning for children in the United States (The National Commission on Teaching and America's Future, 1996; Haynes, 2014; The National Commission on Teaching and America's Future, 2016; National Council for Accreditation of Teacher Education, 2010). While we have made progress in supporting the development of teachers during this time, it has been "uneven" and "haphazard" and the compartmentalized nature of these efforts have often bent to the whims of political pressure (The National Commission on Teaching and America's Future, 2016). Despite these setbacks, evidence continues to mount in support of wide-ranging teacher education opportunities underscoring the importance of initiatives that focus on teacher learning beginning with pre-service teacher preparation and extending throughout one's career. If we want children to have access to capable teachers who meet high expectations for supporting student learning, then we must provide those teachers with rich and authentic opportunities for establishing, developing, and refining strong professional practice.

While there is a clear need and common desire for students to have access to teachers who are experts in enacting their craft, there is far less consensus and much more murkiness about what that means or the strategies that would and could most effectively achieve these aims (Goodwin, 2008). Part of this challenge is due to a perceived gap that researchers and policy makers characterize as leading to differences between what teachers ought to be doing compared to what they are doing and are able to do (Korthagen, 2017). This might also be conceptualized as a theory/practice lag where teachers (un)consciously enact practice bound to theory with

varying degrees of success as they grow over time and attempt to match their vision with actions of classroom practice (L. Goodwin, personal communication April 4, 2019). Additionally, this challenge is a tension that teachers face as they experience dissonance between what they are doing in the classroom and what they wish they were able to do (Wall, 2018). As researchers attempt to clear this obscurity, investigations proliferate in areas such as pre-service and novice teacher identity development (e.g., Chong, Low, & Goh, 2011; Haser & Star, 2009; Proweller & Mitchener, 2004), instructional and pedagogical practices (e.g., Van Hover & Yeager, 2007; Leatham, Peterson, Stockero, & Van Zoest, 2015), motivations and perceptions for practice, (e.g., Watt & Richardson, 2008), reflection in teaching practice (e.g., Orland-Barak, & Yinon, 2007; Zeichner & Liu, 2010), and the work lives of teachers (e.g., Kelchtermans, 2017).

In the United States, research investigating the supports provided for teachers' professional growth are most commonly clustered in connection to specific stages of a teacher's career: (1) pre-service teacher preparation–the time when students prepare to become teachers; (2) new teacher induction – most commonly identified as the first 1-3 years of teaching, when novices are becoming familiar with the ins and outs their new role; and (3) in-service teacher professional learning–the ongoing development that takes place throughout a teacher's career. Varied groups and policy makers tend to narrowly interpret research to conceive solutions that look toward teacher learning in ways that are confined to one or two stages across a teacher's career. This can sometimes result in misaligned supports that, without intentional consideration, can work in opposition to one another across a teacher's career while also overstating solutions as magical remedies meant to achieve utopic teacher quality. In this context, researchers have explored programs, practices and strategies that are being designed and enacted in schools, districts, universities, states, and countries that are meant to support the professional learning of

teachers, including those focused on pre-service program development (e.g., Graham, 2006; Grossman, Hammerness, & McDonald, 2009; Hollins, 2011), induction program design (e.g., Fulton, Yoon, & Lee 2005; Ingersoll & Strong, 2011) and in-service teacher learning (e.g., Bocala, 2015; Wongsopawiro, Zwart, & van Driel, 2017). Research that is focused on the practices and development of those who support new and experienced teachers is also becoming more common, such as studies regarding leadership development in the vein of mentoring new teachers in school settings (e.g., Birkeland & Feiman-Nemser 2012; Nevins Stanulis & Floden, 2009; Trevethan & Sandretto, 2017), research focused on pedagogy and instruction of teacher educators (e.g., Cutri, & Whiting, 2015; Olsen & Buchanan, 2017), as well as a less mature and growing field of research focused on the professional growth and development of teacher educators–primarily in university-based contexts (e.g., Bahr, Monroe, & Mantilla, 2018; Goodwin, et. al., 2014).

While bodies of literature connected to each of these stages offer insight into teacher learning, when taken as a whole, the divisions between stages of development fail to depict sustained and intentional transitions in professional learning over the course of teachers' careers. By focusing on the development of teachers *within* but not *between* specific stages, we miss opportunities for understanding the complex network of how teachers engage, learn from, and are transformed—individually *and* in community—*across* stages of development. The marked absence of this more holistic perspective means that lines of inquiry and communities *of* and *in* practice are isolated from one another, each depicting a story that is only a small piece of the whole resulting in an unfinished portrait that is then used to inform decisions related to teachers' professional practice. Just as the tale of the blind men who were asked to each feel only one part of an elephant and describe its nature led each to independently and inaccurately describe the

whole, we may likewise be missing opportunities for understanding as a result of isolated lines of inquiry and short-sighted approaches in conceptualizing teacher development that account for only individual aspects of a teacher's career.

In the context of the United States, this perspective of isolated teacher development is understandable given popular images of teachers closing the classroom door and working alone with their students. These images impact the culture and beliefs of who a teacher ought to be, what they should know and be able to do, and how they should go about developing expertise in teaching and learning as they begin and continue their careers. As a nation, people are often intimately familiar with the context of schools and have spent much of their early lives observing teachers in action resulting in varying opinions of the qualities that lead to strong teaching practice. There is no other profession with which such a large portion of the population is so familiar, a situation which sometimes leads to inaccurate conjecture about the time and effort necessary to develop essential knowledge, skills, and commitments for effective teaching practice. The best teachers make practice seem easy, often leading to unwarranted conclusions of what is required to develop expertise. However, in many ways this attitude is akin to the frequent concertgoer, who having watched the same piece performed many times, begins to assume that she could also perform as the artist on stage notwithstanding her lack of musical preparation. Not only is this attitude unrealistic, but it also leads to the underestimation of need for access to rigorous, rich, and sustained opportunities of teacher learning necessary to enhance classroom experiences for students in K-12 schools. This is a dilemma that comes with very real consequences because:

> Unless teachers have access to serious and sustained learning opportunities at every stage in their career, they are unlikely to teach in ways that meet demanding new standards for student learning or to participate in the solution of educational problems. (Feiman-Nemser, 2001, p. 1014)

In defining "demanding new standards" but not providing spaces that effectively support the "sustained learning" that is needed to enact them while also shutting down avenues to participate in creating "solution[s] of educational problems," we are unnecessarily setting teachers up to fail and, with them, their students.

Challenges currently being faced by teacher preparation programs in the United States illustrate how current assumptions regarding development of teaching practice can be dangerous, especially when seeking to create conditions where teachers have access to rich and rigorous learning opportunities. In this context, contentions have increased as voices of reform have begun to argue for aggressive shifts in teacher preparation, leading toward the potential dismantling of the university-centered system that now exists. In the name of innovation and led by philanthropists, venture capitalists, "self-proclaimed educational entrepreneurs", and the U.S. Department of Education, this movement seeks to shift much of the teacher preparation process toward independent, private programs that are not held to the same standard as university-based programs (Zeichner, 2016a). While programs such as these claim effective outcomes, there is very little evidence to back these claims. Moreover, teachers are prepared mainly in ways that focus on the narrow development of technical skills that are related to discrete actions and aspects of teaching unlike their counterparts who complete programs to "become professional educators" (Zeichner, 2016b, p.4). Rather than addressing perennial challenges within the system of education, this reform, serves to perpetuate and exacerbate issues of inequity within schools:

> The need to critically consider current trends is also important because teacher quality is interwoven with equity issues. The teachers prepared by these programs overwhelmingly teach in schools located in lower-income communities of color. At a time when inequities among U.S. schools have been documented over and over again, and when schools are steadily becoming increasingly segregated, it is especially important to understand the impact of new programs intended to supply teachers most likely to teach "other people's children" in schools within communities suffering high levels of poverty. It is, after all,

> the perceived lack of highly qualified teachers in such schools that is often used to justify the push for new forms of teacher education. (Zeichner, 2016b, p. 6)

If we are truly interested in supporting the development of high-quality teachers who are able to provide rich and meaningful learning opportunities for students, then we need to be willing to engage in potentially uncomfortable investigations of our practice and conceptualizations of teacher learning. We must also be wary of the promises of reformers who claim to be holding the silver bullet that will solve the problems of education in the United States, because in education, there is no silver bullet. Instead, education holds an opportunity for continued inquiry, exploration, shifting, and learning. These are the fundamental building blocks that lay the groundwork for sustainable transformation. If the quality of teachers working with students is indeed a factor that is as imperative as research indicates, then transforming teacher education—across a continuum of a teacher's career—should be a top priority. However, transformation in this area requires that we focus not only on how teacher learning is enacted and/or supported, but also that we investigate our fundamental assumptions of what teacher education is, how it is enacted, when it happens, and who is part of it.

Establishing the Scope

So how does all of this connect to the idea of an *intergenerational teacher education community*? Central to this idea is a need to investigate assumptions that are related to teacher education and to consider how those added aspects of *intergenerational* and *community* connect with it.

Teacher Education

In literature based in the United States, the term *teacher education* usually refers specifically to the *teacher preparation* that most often happens before someone begins working as a classroom teacher of record (Beck & Kosnik, 2017). However, internationally, *teacher*

education is a term that is increasingly used in ways that "span…initial teacher education programmes, however and wherever these are delivered, and programmes to support teachers' continuing professional development and progression to leadership" (Furlong et al, 2014, p. 6). Teacher education in this capacity assumes a long-term trajectory of learning and development that indicates a need for strong initial preparation that extends to support novice teachers in their first years of classroom teaching and then expands throughout their career (Ertsas, & Irgens, 2017; Fulton, Yoon, & Lee, 2005; Hardy, & Edwards-Groves, 2016). This approach necessitates increased collaboration across the field of education, including joint efforts that are designed to benefit pre-service, new, and experienced teachers, school leaders, and teacher educators.

This framing of teacher education can be conceptualized as *a continuum of teacher learning* (Feiman-Nemser, 2001) which assumes that teachers at different stages in their careers continue to learn and grow but also experience evolving priorities and learning needs as they advance (Beck & Kosnik, 2014; 2017). For instance, pre-service teachers need access to spaces where they are able to actively engage in on-site clinical field experiences that support deeper understanding of student learning. Meanwhile, experienced teachers need opportunities to develop leadership skills and extend their range of responsibilities beyond the classroom. In another case, pre-service teachers need to engage in learning that extends beyond the university context. At the same time, novice teachers need access, time, and space to make meaningful connections with members of local neighborhoods and communities. Similarly, experienced teachers need spaces for reflection on the ever-continuing development of their professional identities and visions of teaching while, likewise, teacher educators need opportunities for refining their professional identities and opportunities to align their work with that of teachers in schools. In each of these cases, the needs of teachers at varying levels of experience are different,

but they also complement each other and open the door for reciprocal relationships within collaborative communities (Goodwin et al., 2014). Making sense of the work of teacher education using a framework that seeks to leverage the overlaps of strength and need between stages along the continuum of teacher learning offers potential, pragmatic, and practical responses that emphasize not just *what* teachers are doing at different points within their careers, but also opportunities for thinking about *how* to support them as the scope for learning is broadened toward a long view.

Conceptualizing teacher education using this broader scope may require a shift in perspective, especially for university-based teacher educators who may need to expand how they think about and approach their roles including considerations of where to situate the focus of learning in pre-service teacher preparation programs. A reimagining may require teacher educators to reallocate time and refocus increased efforts toward identifying strategies for developing reciprocal relationships with school and community members that are built on ideas and exchange of resources that are perceived as beneficial by and for *both* groups. For university-based teacher educators, creating these partnerships requires conscientious and collaborative approaches that account for common goals, varied perspectives, and disparate priorities. For example, university-based educators are primarily concerned with ensuring the learning of pre-service teachers and in thinking about how experiences may support their growth and preparation. To ensure outcomes that are mutually beneficial for schools and universities, educators need to consider how this objective intersects with possible school priorities. For instance, teachers in a school may be working to develop projects that require more adult support and supervision or resources that universities may be able to access and an exchange of these could lead to a new repertoire of rich field opportunities for pre-service teachers.

In the case of the Citizen Scientist Curriculum Team, the residency program became a hub or central point of contact that led to the development of a range of learning opportunities. As a hub, the residency program offered a space for these activities to take place that extended beyond the boundaries of one school leading to a broader exchange of ideas and perspectives (Lee, Akin-Sabuncu, & Pratt, 2024). Because the central point of contact was a teacher preparation program, it also afforded occasions for pre-service teachers to participate in the development and enactment of professional activities alongside new and experienced teachers. Such opportunities included being part of a collaborative instructional team in three-weeks of outdoor field-based learning with high school students. The situation was mutually beneficial with all participants having something to offer and to gain. In addition to the instructive benefits of the pre-service teachers and students who participated in the three-week course, such a complex and rich project also offered a context for refining the practice of all teachers involved as members of the group.

Community

Community in the traditional sense is often framed in two ways. The first is based on physical geography and location such as a town or neighborhood. The second is connected to the relationships that people form with each other and is defined by the "quality of character of human relationship without reference to location" (McMillan & Chavis, 1986, p. 8). Certainly, one or both of these two categories of characteristics can be present for a community to form. In either case, important and defining elements of any community are those factors that provide individuals with an inclination toward the group—a *sense* of community. Sense of community, or "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be

together" (McMillan & Chavis, 1986, p. 9) is further refined through the description and clarification of four elements:

> The first element is *membership*. Membership is a feeling of belonging or of sharing a sense of personal relatedness. The second element is *influence,* a sense of mattering, of making a difference to a group and of the group mattering to its members. The third element is reinforcement: *integration and fulfillment of needs*. This is the feeling that members' needs will be met by the resources received through their membership in the group. The last element is *shared emotional connection*, the commitment and belief that members have shared and will share history, common places, time together, and similar experiences. (McMillan & Chavis, 1986, pp. 8-9)

Creating and nourishing this sense of community is an active and on-going process. As communities grow and change, the sense of community can flourish benefitting not just central members but also those who are peripherally connected (McMillan & Chavis, 1986). Community in this sense most often flourishes when members share a central purpose that they are working to address or enact (e.g., Ross & Coleman, 2000; Staral, 2000; Yeneabat & Butterfield, 2012). On either macro- or micro-scales, when active development of a community wanes or is neglected, the community will decline. This happened, for example, in one city when, over the twenty-year period between 1970 and 1990, policies and social supports prioritized "values of individualism" and "consumerism" (Daley & Marsiglia, 2000, p. 63) over community initiatives that had previously been given precedence leading to a "withdrawal from community life" (p. 63). Given this natural entropic tendency, on-going development is a central factor in supporting the health and well-being of a community.

Development in and of itself presents an opportunity for transformation and is a matter of engaging in a process that sees "…the world constantly created and recreated, invented and reinvented, changed and transformed, and thus – realized by and through human agency which is a this-worldly process of contributing to social changes that bring forth the world" (Stetsenko, 2017, p. 206). This mindset requires not only considerations of development from an individual

perspective (i.e., an individual making the decision to contribute time, energy, or resources to an initiative that effects the community) but also demands "a simultaneously social and individual process of contributing to the future-oriented dynamics of *transformative* shared social practices of communal life" (Stetsenko, 2017, p. 5). However, it is important to not mistake this process of development as simple or straightforward. It is fraught with questions of power, priority, and representation as dynamics within the community push toward norms that inform who makes decisions, how and what changes happen, and who benefits from what the community has to offer. A community united in their efforts offers the powerful potential of change that extends far beyond the capacity of one individual, but at the same time communities bring with them inevitabilities of complexities and messiness.

Even initiatives that are enacted with the best of intentions have the potential to lead to ideas that focus on communities' "needs, deficiencies, and problems" (Kretzmann & McKnight, 1996, p. 23). When considered alongside the idea of sense of community, perhaps the most important consideration when questioning the role of development in a community is whether acts of development lead to increased feelings of belonging and voice or alienation and invisibility. While certainly not an universal solution, one model for addressing some of the (sometimes unidentified) snares of development is the asset-based community development model (Kretzmann & McKnight, 1996). This framework stands in contrast to the more traditional needs-based/problem-based orientations that are directed toward better understanding the deficiencies of a community. Needs-based/problem-based development orientations can become counter-productive as community members "begin to accept that [needs-based] map as the only guide to the reality of their lives. They think of themselves and their neighbors as fundamentally deficient, victims incapable of taking charge of their lives and their community's

future." (p. 24). Alternatively, asset-based community development is grounded in a fundamental assumption that all members of the community have a wide-range of strengths that can be contributed as the group works together toward a variety of purposes. These contributions establish feelings of responsibility, membership and belonging on the part of community members as they continue to work toward their shared aims (Kretzmann & McKnight, 1996). This orientation is associated with three principles: (1) development practices begin with the considerations of the strengths that are present within the community; (2) initiatives are "internally focused" (p. 27) with planning and problem-solving beginning first with members of the community (not discounting the role that outside forces may have played or may be playing at the root of the problem); and (3) development practices are "relationship driven" (p. 27).

In the case of the Citizen Scientist Curriculum Team, members of the group shared feelings of membership and belonging that partially derived from their common connection with the residency program. Members had developed a positive relationship with others after participating in various roles within the broader residency program community context. Later, these relationships became the catalyst for creating new opportunities of learning for both new and more experienced teachers who were part of the group. From the perspective of the residency program, opportunities such as these would have been impossible if new teacher members of the team were seen only as individuals who needed to develop skills and qualities as directed by university-based educators and more experienced teachers. Instead, from an asset-based perspective, new teachers in the group had strengths and resources that they could offer to the community while also learning and developing in that context. For example, new teacher members initiated conversations with other teachers at their schools about the projects that were related to the group. This process often led to other teachers expressing interest in becoming

involved as they saw members as like-minded individuals choosing to come work side-by-side with them to create or enact experiences that would positively benefit teacher and student learning.

In defining an intergenerational teacher education community, the idea of a community *in development* is vital as membership is grounded in principles that account for balance between members' capacity for contribution and their access to resources and learning that fill specific needs.

Intergenerational

The terms *generation* and *intergeneration* are used most often to describe relationships connected to theories of age and aging from the perspective of development over a lifespan. Theorists, for example, have explored concepts such as childhood, youth, or old age (e.g., Barken, 2019; Corsaro, 2017; Farrugia, 2014) and development within a birth cohort that shares a time-based, historical position (e.g., studies of Millennials) (Vanderbeck & Worth, 2015). While some researchers argue for bounding the terms and connecting them specifically to areas of research associated only with age and lifespan, others agree that a more multi- or interdisciplinary approach is warranted and opens the door for new understandings of these ideas if such terms are clearly defined and represented in their applications (Vanderbeck & Worth, 2015).

While not concerned with human development from a perspective of physiological age, the application of the ideas associated with *generational* and *intergenerational* development contain potential parallels in the context of development in professional life. Members of a profession develop in experience and expertise over the course of time and become increasingly able to act creatively and independently within their contexts. This is not altogether different

from our general experiences within a lifespan and extends to patterns and processes that are being studied in the fields of human and community development (e.g., Geeraerts, Vanhoof, & Van den Bossche, 2016; McQuaid, et. al., 2017; Stols, Roos, & Hoffman, 2016).

In human geography, researchers have come to theorize about *intergenerational spaces,* "site[s] that [have] been designed for the purpose of facilitating and promoting interaction between members of different generational groups (most commonly the young and the old)" (Vanderbeck & Worth, p. 1, 2015). Interactions within these spaces initially emphasized forms of intergenerational transmission that were unidirectional in nature—flowing from old to young. However, a newer body of research has extended this idea to include transmissions that are much more reciprocal and has shifted toward discussions of a multi-directional flow between groups. For the Citizen Scientist Curriculum Team, group members in the community included teachers with varying levels of experience, high school students (who eventually graduated and started work on undergraduate degrees), and teacher educators (including me). More experienced teachers were motivated to engage in this project because of the excitement and innovative thinking of members – including those who sometimes had the least teaching experience. As these ideas were implemented, new teachers worked side-by-side with experienced pedagogues who were able to model strong curriculum development strategies to bring learning experiences for students to life in ways that were well-grounded and intentional.

Intergenerational Teacher Education Community

The intersection of these terms—*intergenerational teacher education community*—provides a framework for identifying and understanding the implications of what happens in community spaces developing in ways that take into account a continuum for teacher learning and attempt to intentionally provide opportunities for intergenerational exchange.

The role of university-based teacher educators and spaces of higher education offer another dimension for exploration in this context. This does not mean that all groups that could be defined as intergenerational teacher education communities are necessarily connected to institutions of higher education, but involvement of university-based programs presents an opportunity to reimagine that role. The context of this study is directly connected to a teacher preparation program (the residency program) that has come to act as a sort of hub for the work of the Citizen Scientist Curriculum Team. The framework of the residency program includes components that incorporate continued support for graduates and their teacher colleagues making the program structurally capable of filling this role. In the next section, the core components of the residency program are described and set the stage for understanding the common norms and identity that were integral in the eventual development of the intergenerational teacher education community called the Citizen Scientist Curriculum Team.

Setting the Stage

Understanding the basic elements of the residency program offers some insight into the evolution of the Citizen Scientist Curriculum Team because of the central role the program played in offering a context for the community to develop. Initial members of the Citizen Scientist Curriculum Team were affiliated with the residency program prior to their team membership. Some were pre-service teachers in the residency program while others (myself included) filled a variety of other roles. This shared affiliation meant that the development of our intergenerational teacher education community could be supported by existing relationships and initial common ground from which shared norms and preliminary trust, originating from common experience and affiliation, grew. Understanding the core components of the residency

program adds important insight into the context, decisions, and evolution of the Citizen Scientist Curriculum Team.

The residency program is an 18-month graduate-level teacher preparation program that leads to secondary-level qualifications for teaching. The program is grounded in an aim to support pre-service teachers in becoming well-prepared beginning teachers who plan to enter long-term professional teaching careers working in local public schools. Key characteristics of the program were intentionally developed to emphasize intersections of coursework and field experiences. These were designed to support pre-service teachers in becoming thoughtful, reflective practitioners with growing abilities to critically and creatively imagine, design, and enact meaningful opportunities of learning with their students. This included a full-year residency experience where each pre-service teachers co-planned and co-taught alongside a mentor teacher who was the classroom teacher of record. Mentor teachers were active collaborators in pre-service teacher learning and were also supported by the program as they also grew in their own practice as teacher educators. Each pre-service teacher also worked with a residency supervisor who acted as an advisor and evaluator. Mentor teachers, residency supervisors, and program staff collaborated as a supportive team to ensure that each pre-service teacher had the experiences and opportunities necessary to connect ideas they were learning in courses and to develop the knowledge, skills, and mindsets necessary to be well-prepared to enter their own classrooms.

In working to develop these traits in pre-service teachers, the program actively adopted an underlying framework that was bound to the three philosophical stances of the college: curriculum, inquiry, and social justice. Broad in nature, these terms encompass a variety of perspectives within the field of education and can be interpreted in many ways. In the residency

program's early years, one of the initial tasks of staff members was to interrogate these stances and develop an articulation of how each grounded decision making was enacted by both program staff, pre-service teachers, and other affiliated community members.

In conversations about *curriculum*, the group considered questions of who, how, and why we make decisions about curriculum and the impact these have on students and families with whom we work (Moll, Amanti, & Gonzalez, 1992; Turnbull & Turnbull, 2000). This also included conversation of the nuanced and careful judgement that is practiced daily by effective educators as they make continuous decisions (big and small) about the learning of their students (Darling-Hammond, Wise, & Klein, 1995; Good & Brophy, 1986; Uhlenbeck, Verloop, & Beijaard, 2002). Pragmatically, these ideas were connected to the residency learning experience with an eye toward inclusivity with a focus on learning approaches and strategies of curriculum development through backward design and considerations of universal design for learning. In this context, the aim was to prepare pre-service teachers who would see themselves as agentive professionals who had a continuously growing repertoire of knowledge and skills necessary to make meaningful decisions to support student learning each day. Later, as the Citizen Scientist Curriculum Team took up questions of curriculum, inclusivity and representation within the curriculum continued to be vital topics of conversation. This especially affected questions about who should have access to rich and rigorous project- and inquiry-based learning as, in many schools where teachers were working, these opportunities were reserved for the students who already showed the strongest academic outcomes. This is something that the group was working to interrogate and challenge in our work.

The *inquiry* stance of the program included aspects of raising consciousness that emphasized the importance of asking questions about how and why structures and society are the

way they are. In the foreground of this process was the need for all of us (program staff and pre-service teachers) to delve into our own beliefs about schools and society and consider the roots of our assumptions and experiences about these spaces. Using the work of authors such as Freire (1970) and Dewey (1933; 1916), this stance informed work with the pre-service teachers that focused on interrogating and reflecting on their own growing identities as teachers and developing habits of critical analysis, reflection, observation, data collection, and active responsiveness that could be used to inform their work in the classroom. Iterative cycles of reflective inquiry served as a critical component to of the work of the Citizen Scientist Curriculum Team as the group engaged in on-going cycles of visioning, planning, implementing, and then reflecting all with an eye toward enhancing the practice of individuals as well as the group as a whole.

For the residency program, discussions of *social justice* began by situating the practice of teaching as work that centrally situated in acts that are directed toward meeting the needs of the whole child. In supporting pre-service teachers to develop this stance, knowledge and practice in cultural responsiveness, inclusive practices, and emancipatory teaching integral to their preparation. This included being intentional about taking up stances that encouraged asset-based mindsets about students, families, and communities where teachers were identifying strategies and working toward taking small steps in becoming change agents in schools and communities (Villegas & Lucas, 2002), recognizing institutionalized practices that served to undermine democracy (Shannon, 1993), beginning to experiment with and practice transformative pedagogies (Freire, 1970, 1998), and increasing access to learning designed to meet the needs of all students (Allen, 1999; Beane & Apple, 1995; Greene, 1988, 1995; Shor, 1992). As the Citizen Scientist Curriculum team developed, conversations and applications of principles of social

justice extended to include explorations of and attempts to engage in acts of environmental and educational justice side-by-side with the students with whom teachers worked. Creating change was less about what we were doing *for* students and began to move toward what we were doing *with* students.

From its outset, the residency program was designed to include induction supports to be offered post-graduation. Newly graduated teachers of the program had a broad range of interests and needs. Because of this, induction supports were directed toward offering a wide array of opportunities to leverage the individual professional interests represented among the teachers. Practices were differentiated to meet the needs of individuals—some alumni needed to have an induction mentor's consistent visits and observations paired with recommendations and advice for next steps (the most traditional and common action of a mentor), others needed to watch their induction mentors model specific teaching strategies and then practice those strategies side-by-side with their mentor in subsequent lessons, still others needed time to be able to sit and co-plan with a mentor and discuss possible resources that could be adopted in the classroom. Induction mentors also adopted practices of support that encouraged new teachers in developing habits of self-care—this type of mentoring primarily happened outside of the classroom. Induction mentors took their mentees with them to yoga, joined them in attending professional development workshops, and worked with broader school teams to implement programs and practices in the full school community. This approach to induction encouraged a norm among graduates of sharing ideas and interests with mentors and residency staff that were then used to inform programming and supports offered to all. This is a norm that led to the evolution of multiple initiatives within the program, including the development of the Citizen Scientist Curriculum Team.

I, myself, worked in the residency program for several years prior to the creation of the Citizen Scientist Curriculum Team and, in that time, filled multiple roles. From these positions, I had a multi-dimensional view of the residency program, learning of pre-service teachers, continued growth of graduates, and development of university- and school-based teacher educators. I watched as pre-service teachers worked to engage in and develop an understanding of the nature of learning and teaching while they balanced their own responsibilities as both teacher and student in middle/high school and university contexts. I was part of conversations with program staff where we considered how we might support pre-service teachers in making connections between what they were doing in their placements and university-level coursework. I collaborated with new teachers as they made their first attempts to apply what they had learned—with enthusiasm and trepidation—in new contexts and with the responsibility of being the classroom teacher of record. I was beginning to draw connections between the threads of experience represented along a continuum of teacher learning.

Statement of Purpose

The purpose of this study is to investigate the experiences, processes, interactions, and intersections that are associated with members of an intergenerational teacher education community, the Citizen Scientist Curriculum Team. The aim of this effort is to better understand how aspects of community membership influence the learning outcomes of the community as a whole—as well as individual teachers who are part of it.

This qualitative community-based study will offer an examination of the evolution of the Citizen Scientist Curriculum Team while also focusing on specific moments in time (critical instances) where members of the community were engaged together and working toward a common goal (although not always for the same purpose). In alignment with community-based

qualitative research, I used reciprocal ethnographic tools to collect and analyze data for this study.

In keeping with this research design, my role in this study was two-fold: as a researcher and as a teacher educator. In the role of teacher educator, my position was situated within the community as a member of the Citizen Scientist Curriculum Team who, alongside other community members, was making decisions meant to affect the learning and experiences of high school students as well as pre-service and in-service teachers—including our team. In the role of researcher, my position was one of observer and inquirer who was working to better understand how pre-service and in-service teacher learning connect. I also explored the role that these connections played in sustaining and enhancing the professional learning experiences of teachers across the continuum of teacher learning. More than 20 years ago, Feiman-Nemser (2001) called the development of such a continuum a "radical idea" that would serve to benefit all, but that would require a significant shift in ways that we approached teacher learning. Today, we still know very little about how to make these connections explicit. Likewise, "little attention has been given to the reasons for establishing [it]" (Beck & Kosnick, 2017) but the potential of understanding it better still remains and with that potential comes an opportunity to transform our approach and assumptions that we have about teacher education.

In an effort to begin to better understand how these overarching ideas connected to assumptions and practices related to teacher education, this research is designed to explore instances of learning in community that are experienced by different members of an intergenerational teacher education community. To provide insight into this professional learning, I will consider the following research questions:

1. How does an intergenerational teacher education community develop over time?

1b. When present, what is the role of a university-based program in that development?

2. What is the process of learning and change experienced by teachers who participate as members of an intergenerational teacher education community?

Chapter 2: Reviewing the Literature

In the previous chapter, I discussed the need to develop strategies for supporting teachers across the full continuum of teacher learning. I also described the role of the teacher educator positing that while not the same as a teacher, it shares characteristics that are adjacent to, complementary of, and inform teacher development. If we expect teachers to continuously provide meaningful support for learning that addresses the contemporary needs of students, their communities, and society-at-large, then at every stage of their careers, teachers (and teacher educators) need to have access to robust and authentic opportunities of learning designed to help them engage in continual development (Ball & Forzani, 1999; Feiman-Nemser, 2001). They also need to feel trusted to enact their practice in ways that leverage the strengths and capacities they are able to contribute to the field (Edwards-Groves, Grootenboer, & Ronnerman, 2016; Erichsen, & Reynolds, 2020).

This argument has the potential to encourage boundless possibilities and pathways as skills develop, teaching work evolves, and priorities and interests shift and change over the course of a career. At the same time, it also presumes common principles of learning that are broadly associated with development of expertise and can be used to predict potential opportunities for supporting teachers as they grow and refine their practice and perspectives over the course of time. Extensive, though sometimes conflicting, research has been done exploring ideas of what teachers need to know and be able to do at varying stages in their careers as well as potential structures for support that are meant to encourage professional learning (e.g., Cochran-Smith & Lytle, 2009; Darling-Hammond, 2007; Feiman-Nemser, 2003; Grossman, Hamerness, MacDonald, & Ronfeldt, 2008; Kosnik & Beck, 2009). However, less research has been done exploring how teachers at different stages in their careers might transfer skills and knowledges

between each other within an intergenerational community, where roles and interests differ due in part to varied needs and experiences of each individual. That being said, when looking at researchers' observations and findings in relation to teachers' strengths and struggles across their careers, definite patterns and trends emerge that indicate clear possibilities for multi-directional exchanges across that continuum.

In Table 2.1, pre-service, novice, experienced teacher, and teacher educator columns list needs that researchers have observed in teachers at different stages of their careers. Reading the table vertically does not necessarily present information that is particularly new or surprising. However, when reading the table horizontally, new possibilities for exchanges across the continuum quickly become apparent. In many rows, overlaps indicating complementary needs offer circumstances where teacher communities might benefit from exchanges of learning that celebrate strengths of members while bolstering areas of particular need.

Table 2.1 Cross-section of Research on Teacher Needs at Different Career Stages

Pre-service Teachers Need Opportunities to…	**New Teachers Need Opportunities to…**	**Experienced Teachers Need Opportunities to…**	**Teacher Educators Need Opportunities to…**
Develop a broad, feasible vision of teaching	Continue to work toward the creation of a professional identity	Continue to refine a vision of teaching	Develop and refine identities as a teacher educator – in some cases transitioning from identity as teacher
Be exposed to communities of learning that extend beyond the university	Integrate into school and neighborhood communities coming to know students, families, teachers and other community members	Take on leadership roles that allow them to share knowledge and guide initiatives	Connect to and actively engage with members of local schools and communities
Read, interpret, observe and creatively enact curriculum with students and alongside other teachers	Make decisions about, modify and enact curriculum and instruction in ways that are responsive to students' needs	Extend and refine pedagogical and curricular repertoire	Collaborate meaningfully with university and P-12 colleagues to inform and align teacher and teacher educator practice
Participate in intentional learning and un-learning of pedagogical practices	Practice applying and refining pedagogical ideas and concepts introduced in pre-service programs	Strengthen pedagogical dispositions and skills to study and improve teaching	Construct, understand and enact a pedagogy of teacher education

Actively explore and examine personal stances related to issues of diversity and equity and develop increasingly complex and asset-based understandings of local communities	Begin to establish practices that further examine personal stances on diversity and equity and develop strategies to enact practices that encourage increased understandings of local communities	Refine and further integrate strategies for acting as change agents	Actively reflect on and address issues of diversity and equity within both university and school settings
Recognize conceptual coherence between components of preparation – including connections between field and coursework	Focus on application and enactment of pedagogical ideas within the classroom context	Expand and develop more nuanced approaches for practically enacting learning theory and contribute to shared understanding of this within the school community	Be well informed about research on teaching and teaching teachers as well as how this research is incorporated in practice and enacted at a local level
Balance subject-matter knowledge with the context of subject teaching knowledge	Experiment with various pedagogical approaches for teaching subject matter	Deepen and extend subject-matter knowledge	Extend and refine knowledge of teaching and teaching teachers
Engage in purposeful, integrated field experiences	Engage with others to observe, be observed and reflectively discuss teaching practice	Participate in varied opportunities to share and reflect on teaching practice in community	Develop meaningful and rich experiences for teachers across the continuum of learning

Note: *This table represents potential examples of needs across four teacher divisions (pre-service teacher, new teachers, experienced teachers, and teacher educators). These needs are not all inclusive and also do not represent the individual needs of all teachers at different points in their careers. Rather, they represent a range of needs based on patterns of growth. Adapted from Beck & Kosnik, (2017); Feiman-Nemser, (2001); Goodwin & Kosnik, (2013); Goodwin, Smith, Souto-Manning, et al. (2014); Ladson-Billings (2001); Ladson-Billings, (2005).*

Adding to this overview description of teacher learning, a range of research has been conducted on how professional learning can best support this development (e.g., Dogan & Adams, 2020; Guenther & Wexler, 2021; Bieda & Chazan, 2015). Researchers also largely agree that opportunities for teachers to learn in community represents a vital aspect of effective and positive professional growth for teachers (e.g., Sheridan, & Young, 2017; Kuh, 2016; Hargreaves, 2021; Hardre, Ling, Shehab, Mark, Refai, et al, 2018). There is a strong argument in research for conceptualizing learning as a social practice (Wenger, 1998) and learning in the profession of teaching is not an exception. Certainly, this belief has led to the development of various policies and practices that emphasize social learning among teachers (Vrieling, Van den Beemt, & De Laat, 2016) that are enacted in a range of professional practices such as professional learning communities (e.g., Cheng, & Wu, 2016), lesson study (e.g., Schipper, Goei,

de Vries, van Veen, 2017) , teacher research groups (e.g., Erbilgin, 2019), master teacher studios, and others (e.g., Nicholson, Capitelli, Richert, Baurer, & Bonetti, 2016; McKay & Barton, 2018). At the same time, it is rare for studies to position teachers as the producers of professional learning and, more commonly, situate them as "consumers of others' knowledge and ideas" (Cooper, Fitzgerald, Loughran, Phillips, & Smith, 2020, p. 558). This top-down framing of teacher learning tends to prioritize *uni*-directional delivery of knowledge. For example, studies that focus on the pre-service teacher/mentor teacher relationship tend to frame the pre-service teacher and mentor in a student/expert dichotomy (e.g., Thompson, Hagenah, Lowasser, & Laxon, 2015; Russell, 2015; Mascio, 2018; Casperson, & Raaen, 2014). While these narratives of pre-service teacher learning certainly capture an important aspect learning, there tends to be little consideration of the context as a space for *multi*-directional learning. Yes, the mentor has a wealth of knowledge to share with their mentee, but is there not also something to be said for the opportunity the mentor has to see their teaching practice through a new perspective? Far less research has been done that considers these possibilities as well as the communal transfer of skills and knowledge within an intergenerational community from a multi-directional perspective.

The term I have chosen to describe the intersections that make up learning communities across this continuum, *intergenerational teacher education community*, is one that is original to this study. The term is designed to capture a combination of practices that likely are occurring in a variety of contexts but may also be invisible, limiting their potential to augment teacher learning. The aim of this literature review is to attempt to make visible those invisible intersections to better understand how research has captured the learning exchange of communities of teachers who represent a wide spectrum across the continuum of teacher

learning. To do this, my literature review will focus on a bounded sample of literature that was selected to represent current research that is being done on teacher education both in the United States and internationally. The review will explore the following questions:

1. How are researchers talking about teachers across a continuum of teacher learning?
2. How are researchers talking about teachers who are engaged in learning as a community or group?

In situations where literature meets the criteria of *intergenerational teacher education community* what are researchers' observations of teacher learning in this context?

Methods

In order to get a sense of how characteristics of intergenerational teacher education communities are represented as well as their frequency in current literature in the field of education, I surveyed a sample of literature that represented research published specifically in the field of teacher education.

The initial body of literature included all peer-reviewed articles published in four peer-reviewed journals in the last five years that have a common mission that focuses on collecting and disseminating research in the field of teaching and teacher education. Four journals provided breadth in terms of the range of research being investigated and published while also limiting the sample to a manageable number. My choice to look at an even number of journals also made it possible to select an equal number of journals with a national and international focus. My selected time range, from 2014 through 2021, provided a timeframe that particularly emphasized contemporary (as opposed to historical) conversations in teacher education in order to have a sense of how the concept of an intergenerational teacher education community fits into current conversations taking place in this field. This timeframe also offered literature that was published

prior to and following the COVID-19 pandemic, a time that had a significant impact on many facets of teaching practice.

Journal Selection

As stated above, the journals selected for my review sample were all peer-reviewed and have missions that focus specifically on teacher education. Journals with a wider education focus were excluded from the list of possible journals. For example, while publishing a good amount of research that is focused on teacher education, *Teachers College Record* publishes a wide-range of work in the field of education and was therefore excluded from the list of possible journals to be considered. Of journals that address teacher education, all four journals have either a national focus that is centered in the United States or an international focus. This means that journals such as *European journal of teacher education* and *Asia-Pacific journal of teacher education* were excluded from consideration. With these criteria in mind, the four journals that were used for this survey were: *Teaching and teacher education* (international), *Teachers and teaching* (international), *Journal of teacher education* (national), and *Teacher education quarterly* (national).

First Stage Analysis: Article Categorization

Across the four journals, 1,452 articles were coded and categorized based on article type, participants, and unit of analysis. For purposes of this review, I prioritized empirical studies within the analysis. This means that while I did take into account information from literature reviews, policy briefs, and conceptual papers that were relevant to my inquiry, final steps in this analysis looked specifically at empirical research. Because of this, articles were first categorized based on article type (i.e., empirical study, conceptual paper, literature review, or policy brief).

Empirical articles were coded based on whether teachers and/or teacher educators were participants of the study and sub-categories of participants (i.e., pre-service teacher, novice teacher, mid-career teacher, veteran teacher, in-service teacher) were also noted. In cases where the study focused on in-service teachers within a range of teaching experience but did not provide analysis that made distinctions between those stages of experience, the participants were coded as "in-service teachers" rather than making distinctions across experience levels. In cases where the researcher distinguished between level of experience, those specific levels were identified. When distinctions were made, participants were categorized based on the definitions that were outlined by the authors. For example, one author may define "novice teacher" as a person in their first to third year of teaching while another may define "novice teacher" as a person in their first to fifth. Regardless of these differences, if the author(s) defined their participants as novice teachers then the study was coded as focusing on novice teachers. Articles were categorized in this way in order to maintain a sense of frequency of topic (while there may not necessarily be consistency in definitions across articles). For purposes of this study, the most important factor to consider is whether teachers *across levels of experience* are being studied together. Consequently the consistency of definition between articles was less relevant.

Articles that focused on research participants who were not teachers were removed from consideration. For example, articles focusing only on principals or children were excluded from review. Articles that included a combination of participants such as school leaders *and* teachers were included in the study.

Articles were also categorized based on the unit of analysis and differentiated between situations where the research defined the unit as a group and/or community as opposed to focusing on the isolated actions and/or beliefs of teachers. If participants in the study interacted

as groups or communities, then the study was coded as a group study. The study was coded as isolated if the participants would not have needed to (or did not) interact or know each other as the study was being conducted. Finally, articles were coded based on the country where the study took place. This was done for the purpose of potentially identifying country-specific patterns or trends where research might emphasize a tendency toward studying teacher collaboration and community learning.

Second Stage Analysis: Identification of Potential Patterns and Trends

After the preliminary categorization of articles, I looked specifically at those articles that were coded as having participants that represented a continuum of teacher learning and were conducted using a group/community unit of analysis. Within this cluster of articles, I looked for patterns and trends that were common across the studies as well as contradictions between them. Within this analysis, I also looked specifically for articles that provided examples of groups that could be defined as intergenerational teacher education community and considered insights that might come from the findings that these articles shared.

Third Stage Analysis: Making Visible Intergenerational Teacher Education Communities

In my final stage of analysis, I looked within the body of literature that I read from the second-stage of analysis for articles that covered the broadest spectrum of the continuum. These were articles where at least four categories of teachers—ideally including pre-service teachers—were clustered and participants engaged in some kind of community or group interaction. I then re-read these articles as a unit to look for additional insights and to also better understand how researchers are discussing and making sense of learning in communities that represent this broad range of experience.

Analysis

Table 2.2 offers an overview of the articles analyzed for this review. Helpful patterns and trends emerged providing useful insights that illuminate assumptions, understandings, actions, challenges, and contradictions. These components form the foundations on which structures of learning for teachers and teacher educators are built.

Table 2.2 Overview of Articles Analyzed

Journal	Peer Reviewed[1]	Teacher/ Teacher Educator[2]	Continuum of Learning[3]	Group Unit of Analysis[4]	Continuum & Group[5]	ITEC w Pre-service[6]
Total Articles	2,293	2,103	410	418	133	33
Journal of Teacher Education	266	200	39	48	17	6
Teacher Education Quarterly	165	143	21	42	11	4
Teachers and Teaching	410	354	66	54	20	2
Teaching and Teacher Education	1,452	1,319	384	274	85	21

Note: [1] Included empirical articles, literature reviews and conceptual papers. Editorials within the journals were not included.
[2] Included empirical articles where teachers and/or teacher educators were participants in the study. Participants were classified in sub-categories: pre-service teacher, novice teacher, mid-career teacher, veteran teacher, in-service teacher, teacher educator.
[3]Studies where participants included members of more than one teacher sub-category. In instances where in-service teachers were studied, a spectrum was included only when notated in the study. When a spectrum was not notated, in-service was marked. In instances where one teacher category was the focus (such as novice teacher), only that category was marked even though this group also fits in the in-service teacher category.
[4] Studies where the unit of analysis was a group of teachers. This could include studies where methods were individualized (all members of the study were interviewed individually) but the research questions were focused group dynamic or interactions as a unit. These studies also included instances where a full group was studied together.
[5] Studies where participants in more than one sub-category were studied using methods that analyzed a group of teachers as a unit.
[6]Studies where participants in more than one sub-category were studied using methods that analyzed a group and included pre-service teachers as participants

Stages of Teacher Learning Along a Continuum of Teacher Learning

Within the literature gathered for this review, many studies were framed in ways that offered insight into how researchers are talking about teachers across the continuum of teacher learning. This includes studies that accounted for individual stages of teacher development as well as those that looked across multiple stages of development.

Pre-Service Teacher Learning. Empirical studies that focused on pre-service teacher experiences were generally designed to inform the process of pre-service teacher learning, to

"gain insight into the complexity [that pre-service teachers are] navigating" (Mascio, 2018, p. 24) as they learn to teach as well as to better understand the general practices of preparation programs. This included studies that were developed for the purpose of describing, understanding and then codifying practices that address discrete problems pre-service teachers regularly faced (e.g., Keppens, Consuegra, Gossens, De Maeyer, & Vanderlinde, 2019; Kim, & Corcoran, 2018; Maulana, Helms-Lorenz, & Van de Grift, 2017; Todorova, Sunder, Steffensky & Moller, 2017), examining the evolution of perspectives, beliefs, and identity development (e.g., Chung-Parsons, & Bailey, 2019; Leeferink, Koopman, Beijaard, & Gonny, 2019; Sugimoto, Carter, & Stoehr, 2017) and interrogating and generating new strategies for supporting initial teacher development primarily in university-based pre-service teacher preparation contexts (e.g., Coffey, Putnam, Handler, & Leach, 2019; Rubin, Abu El-Hag, Graham, & Clay, 2016; López Solé, Zaragoza, & Diaz-Gibson, 2018). While topics could be easily categorized, findings across these studies did not necessarily align as researchers emphasized different priorities and values that directly affected how they talked about supporting pre-service teacher development.

Taking an area of pre-service teacher need from Table 2.1 such as "developing a broad and feasible vision of learning" offers insight into how these ideas may not align. For example, two sets of researchers set out to examine aspects associated with this need. The aim of the first study was to better understand strategies for supporting pre-service teachers in coming to see "what kids *were* doing, not just what they were not, and to see children not just as students, learners, or objects of adults' socialization efforts but as full human beings and active agents in their own processes of development" (Orellana, Johnson, Rodriguez-Minkoff, Rodriguez, & Franco, 2017, p. 22). This endeavor to "see learning so as to better understand children and their ways of making meaning" (p. 21) highlights the process of supporting pre-service teachers in

coming to recognize aspects of learning that may have been previously invisible to them. In this case, a mechanism that mediated the evolution of these understanding was the reflective work of the pre-service teacher in connecting theory to practice. This included contending with "struggles around if, when and how to mediate children's learning in particular ways, and on the challenges of building and acting within a community of learners" (p. 22). In this way, the pre-service teacher was directed toward seeing learning in new ways that were previously invisible. A second set of researchers also set out to make pre-service teacher practice more visible, positing that "video self-reflections can be an effective self-development tool for student teachers; however, its value is often limited as video provides only one perspective of the classroom" (Walshe & Driver, 2019, p. 97). In this case study, the view of what pre-service teachers saw was expanded through the use of 360-degree video, "an immersive type of content which allows the viewer to look around in all directions, giving them choice and control over what they see" (p. 98). After watching these videos, participants shared observations that were "significantly more detail[ed]" (p. 101) and offered new perspectives of what they had done while teaching. Participants were able to identify opportunities for shifting instruction (e.g., "when I am in the classroom I just go to the children with their hands up," "quite a lot of them were a little bit confused," (p. 101)). This experience resulted in participants thinking differently about how they might prepare and enact instruction in the classroom. In both studies, researchers investigated how pre-service teachers focused on developing new perspectives and understandings of what they see in the classroom. In the first example, this new sight centered on the pre-service teacher's fundamental assumptions for student learning and how those assumptions affect teacher decision in the classroom. In the second, researchers investigated how pre-service teachers develop new perspectives using strategies that focused on discrete actions made and observed by

pre-service teachers. Both examples inform attempts to broaden pre-service teachers' visions of their own practice but prioritize different mechanisms for triggering the change in perspective. As we consider the growth and development of pre-service teachers, how do we provide a wide enough range of opportunities that will support a deeper, broader, imaginative, and more focused vision for teaching?

Novice Teacher Learning. As was the case with literature that focused on pre-service teachers, some research within the corpus of literature focused specifically on novice teachers and their transition into the classroom. This included literature that examined attrition and career orientations for new teachers (e.g., Cabezas, Paredas, Bogolasky, Rivero, & Zarhi, 2017; Fitchett, McCarthy, Lamber & Boyle, 2018; Gallant & Riley, 2017; Harmsen, Helms-Lorenz, Maulana, & van Veen, 2018), professional learning through a variety of means including new teacher mentoring and induction (e.g., Desimone, Hochberg, Porter, Polikhoff, Schwartz, & Johnson, 2014; Mitchell, Howard, Meetze-Hall, Hendrick, & Sandin, 2017; Polizzi, Head, Barrett-William, Ellis, et.al., 2018), identity and processes of becoming a teacher (Ballantyne & Zhukov, 2017; Juutilainen, Metsäpelto, & Poikkeus, 2018; Shim, 2018; Trent, 2018; Popper-Giveono, & Shayshon, 2017), instructional practices (Brown, 2015; Cohen, 2018; Smith, Anderson, and Blanch, 2016; Windschitl & Stroupe, 2017) and new teachers' engagement in developing inclusive, culturally relevant practices (Brownlee, Scholes, Walker, & Johansson, 2016; Picower, 2015; Coffey, & Farinde-Wu, 2016; Westbrook, & Croft, 2015).

A large number of studies within this body of literature emphasized the struggle, tension, and discord faced by novice teachers resulting in negative influences on job satisfaction which can lead to new teachers ultimately leaving the profession (e.g., Lindqvist, Weurlander, Wernerson, Thornberg, 2017; Vaitzman Ben-David & Berkovich, 2021; Deng, Kiramba, &

Viesca, 2021; Windschitl, Lohwasser, Tasker, 2021; Henry, Purtell, Bastian, Fortner, Thompson, Campbell, & Patterson, 2014; Mintz, et. al., 2020; Thomson, Walkowiak, Whitehead, Huggins, 2020; Klassen, Durksen, Al Hashmi, Kim, et al. 2018; Chaaban, & Du, 2017). However, these findings also represent an opportunity to rethink novice teacher support in ways that both look back to their pre-service teaching experiences and forward toward strong development of identity as a teacher. For example, in one study, novice teachers in New Zealand talked about the challenges of grappling with national standards in their classroom practice (Smith, Anderson, & Blanch, 2016). In this instance, teachers shared feelings of "frustration" as they attempted to support learning that aligned with these expectations expressing that "[the national standards] are quite arbitrary and…if you're not going to meet the line, you've still made progress and…if [students] from 'at' to 'below' it's not [that] they've learnt nothing at all…they just haven't progressed as much" (p. 111). In this case, novice teachers were using their developing professional expertise as they grappled with the challenging dilemma of balancing expectations of meeting standards with their own vision of teaching. This is a common challenge faced by teachers of all levels of experience. In another study, veteran teachers were able to respond to this challenge of "navigat[ing] prescriptive curricular mandates…[by] us[ing] their professional expertise and professional agency to respond strategically" to new expectations in their context (Dover, Henning, & Agarwal-Rangnath, 2016, p. 458). When juxtaposing these novice and veteran teacher experiences, research found that this standards dilemma required veterans to also actively consider how changes in expectations fit within the existing threads of their practice. For example, one teacher stated:

> Social studies teachers are called to push the envelope. In this way, we are simply following in a tradition of educators who sought to help students understand their imperfect worlds. We should draw strength from this idea and recognize that when we teach for social justice, we are not alone, and that CCSS represents a roadblock, yes, but

> not one that is insurmountable. Rise up. (Dover, Henning, & Agarwal-Rangnath, 2016, p. 464).

This response to the standards dilemma is fundamentally different from that of novice teachers who responded to instructional expectations in ways that defined who they were as teachers. Veteran teachers, on the other hand, had a much greater capacity to place dilemmas within the wider landscape (e.g., Wolff, Jarodzka, & Boshuizen, 2017; Stahnke & Blömeke, 2021; Thompson, Hagenah, Lohwasser, & Laxton, 2015). Those veterans who were particularly effective also tended to focus their efforts on "the 'who' and 'how' of teaching" as they stepped outside of the minutiae (Hatch & Clark, p. 11). One teacher, for example, described his own responsibility as a teacher as one that encompassed decisions about how to interact and respond to the standards and also recognized that, "if you don't like the current direction of curricular reform, take heart, it may not last" (Dover, Henning, & Agarwal-Rangnath p. 464). Thus, the difference between notice and veteran responses was not the dilemma but the capacity that is developed over time to be able to navigate (and at times float above) constant shifting currents. Certainly, it is to be expected that novice teachers would engage with such dilemmas with less finesse and acumen than veterans. This emphasizes a need for community structures that provide novices with the opportunity to work side-by-side with veteran teachers sharing common purpose in ways that alleviate some of the stresses that come from the newness of the profession. Moreover, such practices enhance solidarity and bandwidth, which can create space for veteran and novice teachers to meaningfully contribute to the work of the school. One need of novice teachers is to "engage with others to observe, be observed and reflectively discuss teaching practice" (see Table 2.1). Expanding this in purpose to all professional practice and thinking deeply about the process that could support this presents important opportunities.

Experienced Teacher Learning. Adding to the research focusing on pre-service and

novice teachers, some studies attended to the experiences and professional growth of mid-career and/or veteran teachers. The aims of these studies were most often to explore opportunities for leadership development – including roles that intersect with teacher preparation such as mentor teacher (Elison, Anderson, Aronson, & Clausen, 2018; Klein, Taylor, Manakata, Trabona, Rahman, et. al, 2018; Sheridan, & Young, 2017), understand how professional development and/or instructional programs are being enacted in the school context (Chang-Kredi, 2015; Lopes, & Cunha, 2017; Pawan, & Fan, 2014; Sharkey, Olarte, & Ramirez, 2016), to consider how teaching practice should be evaluated (Bradford, & Braaten, 2018; Charalambouse, Komitis, Papacharalambo, & Stefanou, 2014; Lejonberg, Elstad, & Christophersen, 2018; Salazar, 2018), and to explore teachers' attitudes, beliefs and experiences in teaching (Abós, Haerens, Sevil, Aelterman, & Garci-González, 2018; Gindi, & Erlich, 2018; Holbert, 2015; Rojas, & Liou, 2017).

As teachers become more experienced and shift into later stages of their career, new opportunities can potentially open, offering avenues for teachers to engage in and make sense of their professional learning in alignment with their evolving needs such as "tak[ing] on leadership roles that allow them to share knowledge and guide initiatives" (see Table 2.1). Studies that focused on the learning of these two groups of teachers included investigations of how teachers extended, expanded, and sustained their professional roles (Aderet-German, & Dromi, 2021; Guenther & Wexler, 2021; Shirley, Hargreaves, & Washington-Wangia, 2020). This practice includes teachers who collaborate with pre-service teacher preparation programs as mentors, teachers who find ways to lead from the classroom by exploring education adjacent opportunities such as participating in the development of educational policy; and teachers who seek out spaces that offer sustaining supports such as teachers of color who often face a "hostile racial climate in

schools", especially in the United States (Kohli, 2019, p. 39).

Several studies within the corpus of literature explored the role of mid-career and veteran teachers as mentors (e.g., Bleda, Sela, & Chazan, 2015; Desimone, Hochberg, Porter, Polikoff, Schwartz, & Johnson, 2014; Zygmunt, Cipollone, Tancock, Clausen, Clark, Mucherah, 2018). Within this literature, some studies investigated mentor learning as experienced teachers navigated new dilemmas and considered how to best support less experienced (soon-to-be) colleagues. For example, in one study researchers investigated the complex dynamics of the mentoring relationship (Sheridan, & Young, 2017). To support strong pre-service teacher learning, experienced teachers worked to develop the ability to engage in "genuine conversations" which are integral in "supporting [pre-service teachers'] identity, as well as guiding their teaching practice" (p. 659). In many instances, tensions emerged between the mentor and pre-service teacher as pairs attempted to converse while mentors also grappled with finding ways to support the pre-service teacher to "speak frankly about their experiences with the mentor" (p. 668). These dilemmas inhibited the ability for the pair to engage in "conversations that create shared understandings" (p. 668) or that led to sharing of resources or meaningful feedback on the part of the mentor. While mentors might have experienced confidence in the support and instruction of students in their classrooms, this new role required the development of additional knowledge, skills, and mindsets as experienced teachers developed new aspects of their professional identity (Roegman, & Kolman, 2020).

Another example of experienced teachers extending their role includes opportunities to engage in education-related conversations that are adjacent to classroom practice such as those focused on educational policy. For example, in one study experienced teachers were invited to participate in an international conference that included policy makers, researchers, and

practitioners. In the course of this conference, teachers participated in a series of workshops as well as a "joint teacher-policy-maker panel" (Lefstein, & Perath, 2014, p. 33). In this particular situation, teachers were shifting from their familiar classroom context into a situation that included systemic, structural, and organizational components with which they were less familiar. In analyzing patterns and trends of participation in the conference, researchers found an imbalance between teacher voice in comparison with other participants of the series. The ideas and issues voiced by teachers tended to be set aside in deference to ideas being voiced by other participants. To illustrate:

> Salary conditions emerged in the workshop as a central concern for many participating teachers yet were largely marginalised through the subsequent processes of discussion, formulation, presentation and summary. Instead, the issue of trust, which had received relatively scant attention, was presented as the key issue in the concluding session and report. (Lefstein, & Perath, 2014, p. 42)

Researchers indicated that contributing factors to this outcome were teachers' "social position" within the group as well as the "uneven distribution of *repertoires*" (p. 42). While invited as members of the conference, teachers were engaging in a context unfamiliar in terms of structure, system and form. The space required the use of different language patterns and strategies for argumentation than they would typically use in the classroom. These elements contributed to an imbalance of voice that was only perpetuated by the unfamiliarity of the context. At the same time, participation in the conference offered teachers an opportunity to begin to extend their already existing professional knowledge.

Experienced teachers also used professional learning spaces designed to sustain teachers as they face isolating aspects of their work. In the United States, spaces such as these are especially important for teachers of Color who often face "dehumanizing" (Kohli, 2019, p. 29) and "alienating" (Bristol, & Goings, p. 51) experiences that result in a specific need for "collectivized teacher-led spaces" (Kohli, 2019, p. 39) that can be used to sustain and uplift. In

one study (Kohli, 2019), experienced teachers reflected on their pre-service teacher preparation offering insight into the shortcomings of teacher preparation programs with regards to developing racial literacy. They discussed experiences where program stances were misaligned with or "contradicted the justice orientations of teachers of Color." (p. 43). In preparation programs where social justice stances *were* aligned, teachers still left ill-prepared to "navigate racial hostility in the field" (p. 43). This long-view retrospective offers important and nuanced insights into the practices and outcomes of teacher preparation, especially for teachers of Color, and underscores the importance of intentionally preparing teachers to make intentional decisions for finding communities that will sustain them in the profession. For example, in one case, Bernice, one teacher of Color who "found a way to not only persist, but to also shine as a racial justice teacher leader" (p. 39), found "a like-minded community in which to strengthen her racial literacy—skills to understand and interrogate racism embedded in institutions" (p. 40).

Kohli (2019) observes that modified critical professional development (CPD) spaces can offer important supports for pre-service teachers who are learning how to "confront racialized structures and school inequity" (p. 40) and considers a potential translation of this in-service teacher learning strategy into a pre-service learning context. When examining these ideas through an intergenerational lens, combining pre- and in-service teacher learning contexts offers another potential opportunity. This is *not* to say that experienced teachers of Color should shoulder the responsibility for cultivating a space for pre-service teachers to develop racial literacy. Rather, it is meant to highlight the importance for university-based teacher educators to consider how they might contribute to the local landscape of developing CPD communities in ways that account for the development of sustained spaces where pre-service teachers are introduced to justice-oriented work in ways that point toward on-going participation that

naturally extends beyond their pre-service preparation program. Experienced teachers need opportunities to take on leadership roles that allow them to share knowledge and guide initiatives (Table 2.1), invitations to act as thought partners who are also being honored, sustained, and supported in their work could offer a context for this to happen.

Findings from all of these cases underscore the importance for experienced teachers to have the opportunity to work to develop new knowledges, skills, and ways of thinking that run adjacent to but are not the same as those used in the classroom context. They also emphasize the need to consider what access teachers have to communities that sustain them in their practice. This includes exploring strategies for communicating ideas to new audiences and in new contexts as well as considering how to make unseen aspects of their professional practices visible to a wide range of people. When approached from a perspective of learning, opportunities such as these have the potential to reengage and revitalize professional learning for mid-career and veteran teachers as they sustain and extend their role within and beyond the boundaries of the classroom.

Veteran Teacher Learning. While sparse, there are a few articles within this corpus of literature that focus on teaching practice of veteran teachers and account for their reflections as they look back across the course of their careers (e.g., Gray, Lowe, Prout, & Jefferson, 2021; Acosta, 2019). Such a small number of studies within this body of research is likely partially due to the difficulty of publishing longitudinal research with its vast scope in article form. However, researchers have also pointed out that there is a general absence of longitudinal studies that follow the developmental life of teachers (Beck & Kosnik, 2014). The purpose of longitudinal research is to explore how time and change effect the experiences of participants (Saldaña, 2003). This purpose intersects with aims to understand growth of teachers across a continuum of

teacher learning. This cluster of research is important to highlight because of the insights that it provides in thinking about the individual experiences of teachers as they progress through their careers.

One such study within my survey of literature that took on a long-view of teacher learning was a life history (Thorburn, 2014) that focused on "Jack" who "taught physical education on a non-promoted basis in the same secondary school…in an area of social deprivation in the west of Scotland" (p. 441) for more than thirty years. This study highlights the inevitability of the ebbs and flows within a teaching career with Jack describing experiences that Thorburn categorizes as "the best of times" and others as "the worst of times" (p. 441). For Jack, these Dickensian juxtapositions represented his own professional shifts and changes while engaging in teaching practice in an ever-evolving landscape that sometimes influenced decisions and considerations for growth over the course of time. This study highlights an important long-view perspective that underscores the experience of struggle as a natural component of teaching. Jack reflected that his ability to engage in a long-term teaching career came less from a lack of struggle or disappointment and more from an ability to flexibly interact with it. In a situation where newer teachers are actively working side-by-side with those who are more experienced, how might veterans model practices that sustainably respond to the ebbs and flows of teaching practice?

While there were very few long-range studies that focused on the experiences of veteran teachers, there were other longitudinal studies that were much smaller in scope and that investigated the experiences of pre-service teachers including those that examined how they transitioned into their own classrooms as novices. While several studies within this portion focused on change within a particular stage such as pre-service teacher development over the

course of participants' preparation programs (i.e., Blömeke, Buchholtz, Suhl, & Kaiser, 2014; Charalambous, Philippou, & Olympiou, 2018; Hauerwas, Skawinski, & Ryan, 2017), some used a timeframe that extended beyond one stage of teacher experience

Teacher Educator Learning. In addition to studies that focus on stages of teaching that range across a K-12 teaching career, relatively new lines of inquiry highlight studies that are focused on the experience and development of teacher educators, which offers new dimensions for investigating exchanges of learning and opportunities for growth. The increased attention to this research focus as resulted in more investigations including those meant to better understand what teacher educators should know and be able to do (e.g. Acosta, Foster, & Houchen, 2018; Alvunger & Wahlström, 2018; Goodwin et. al., 2014; Hadar & Brody, 2018), examine intricacies of supporting pre-service and (sometimes) in-service teachers (Bhukhanwala, Dean, & Troyer, 2017; Instefjord, & Munthe, 2017; Olsen & Buchanan, 2017; Von Esch, & Kavanagh, 2018), and explore political, personal and pedagogical challenges faced by teacher educators (Dharamshi, 2018; Dunn, 2016; Kohli, 2019; Patton, & Parker, 2017).

From this research, we know that most teacher educators tend to "fall" into the profession but also recognize that the process of shifting "from teacher to teacher educator is fraught with challenges" (Goodwin, et. al., 2014, p. 285) with even those who aim toward this profession receiving very little intentional preparation. Also, teacher educators need opportunities to "collaborate meaningfully with university and P-12 colleagues to inform and align teacher and teacher educator practice" (see Table 2.1). Participation in intergenerational teacher education communities cannot act as the final solution for addressing all dilemmas faced by teacher educators. Nevertheless, being situated in contexts that allow for thinking and re-thinking about the implications of their work enhances the development of teacher educators. Furthermore, it

also potentially facilitates long-view perspectives that anchor efforts to support pre-service teacher development in a broader professional learning context.

Looking Across Stages of Teacher Learning. Studies that examined teacher transitions from pre-service preparation programs most often extended into the first to third year of teaching as novice teachers (i.e., Thomson, Huggins, & Williams, 2019; Wetzel, Hoffman, Roach, & Russell, 2018) with one study presenting results that are nested within a longer-term project (Sydnor, 2014) and one study sharing data that began while teachers were in their pre-service program and extending six years into their careers (Wall, 2018). These studies described pre-service preparation contexts that were designed to support teacher learning and that provided space for creating a vision for becoming a teacher, developing "practical knowledge by approximating the models of practices espoused by the program" (Wetzel, Hoffman, Roach, & Russell, 2018, p. 97), collecting a foundational repertoire of skills and knowledges meant to be applied in the classroom, and reflecting on learning in multiple contexts. This pre-service stage was one where teachers experienced opportunities to "actively construct [their learning] in response to social interactions through social negotiation, scaffolding by 'more knowledgeable others,' discourse, reflection, and explanation" (Wall, 2018, p. 31) with the safety net of supportive preparation programs. Across the studies, as participants transitioned from the role of pre-service teacher to that of novice teacher, they tended to experience feelings of "dissonance" (Wall, 2018, p. 26), uncertainty, and stress as they worked to independently apply new knowledge and skills in even newer classroom contexts. In the course of these experiences, novice teacher beliefs and perspectives about teaching, learning, students, schools and themselves became more complex and refined as they contended with how their ideas played out in their own classroom spaces. A synthesis of these studies supports conclusions that "re-affirm

that teaching efficacy is *task* and *context specific,* and that teaching efficacy is dependent on an array of contextual factors" (Thomson, Huggins, & Williams, 2019, p. 264) and also further clarifies how, "struggles experienced within the preservice program support[ ] teachers in negotiating tensions in the first years" (Wetzel, Hoffman, Roach, & Russell, 2018, p. 106). While unsurprising, these considerations that underscore the messiness of the transition between pre-service and novice teacher offer important insight into "this uncomfortable process of becoming and the various discourses circulating through it in order to properly support teacher candidates, student teachers, and beginning teachers during this journey" (Sydnor, 2014, p. 118).

Certainly, these findings demonstrate the importance of thoughtful and relevant teacher preparation programs and indicate a need for equally robust new teacher induction supports. These overlapping needs also reveal the potential for teacher educators—whose roles are often limited to interactions with pre-service teachers—to reimagine ways to expand their support to account for the sometimes messy and unpredictable elements that are a natural part of this transition. Although studies have indicated that we are well aware of the struggle of novice teachers, the responsibility for navigating this abrupt shift seems to have been mostly placed in the hands of new teachers themselves as we watch from the sidelines and bemoan their predicament. What we say may align with these realizations, but in action, supports of new teachers indicate just the opposite: a *learn then do* approach that maintains an expectation that well-prepared beginning teachers should be just as skilled as those who have spent years refining their practice.

Teachers Learning in Community

Within the corpus of literature, collaborative practices of teachers were studied in a variety of ways offering insight into structures such as communities of practice, teaching

research groups, critical friends groups, lesson studies, arts-based theater learning, cross-professional collaboration, and teacher study groups. Within the cluster, studies most often grounded understandings of collaboration in principles of social learning theory. This included concepts such as mutual engagement, joint enterprise, and shared repertoire—all features of social learning theory (e.g., Sheridan & Young, 2017; De Neve & Devos, 2017; Peercy, Martin-Beltrán, Silverman, & Daniel, 2015; Knight, 2017). Studies such as these provide insight into a spectrum of approaches for developing communal learning spaces across the continuum of teacher learning with findings often emphasizing the complexity (and sometimes chaos) of the collaborative process.

One study exploring collaborative learning spaces in a school in China (Yuan, Zhang, & Yu, 2018) provides an illustration of the complexity of this process. In this case researchers observed ebbs and flows in the group dynamic of a professional learning community as members worked through a process of "constant self-organization in response to changing situations and external stimulus" (p. 532). The group evolved over time as they worked to define a shared purpose and mediate expectations from school leadership. At one point in the process, an experienced teacher on the team negotiated with school leadership to address the dilemma. This led to increased autonomy for the group allowing them to "explore new ways to improve their collaborative practices" (p. 530). The evolution of the group included components of complexity, chaos, and messiness that align with descriptions of other collaborative learning spaces (e.g., Charteris, Wright, Trask, Khoo, Page, Anderson, & Cowie, 2021; Bahr, Monroe, Mantilla, 2018; Fleer, Fragkiadaki, & Rai, 2021). A key factor in considering this case was the patience necessary to let the group evolve. This did include some support from school leadership but it wasn't until teachers negotiated for decreased control that they were able to "address the

disequilibrium in the collaborative system" (p. 530) with nuance and sensitivity to the collective needs of the group. The efforts of pushing toward autonomy and taking ownership of the group led deeper and more effective collaboration within the group.

In a second study, researchers (Wongsopawiro, D.S., Zwart, R.C., & van Driel, J.H., 2017) sought to understand elements of support for teachers that would lead to a change informed by "knowledge, beliefs, and attitudes" (p. 194) and that would also offer shifts in classroom practice. Changes in teaching practice encompass "a complex system of processes in which teachers are engaged in active and meaningful learning" (p.194). The mechanism for change in this study was teacher action research. Over the course of a year, a group of teachers engaged in projects, each specific to their own classroom. To implement the process, the researchers offered a series of professional development sessions (a two week summer institute and four meetings during the year) that were attended by the teacher participants. All sessions were facilitated by university staff. In this context, where university faculty, literature reviews, and peer discussions with facilitation of university faculty contributed "most in helping participants define science curricula and in construction knowledge of student understanding" (p. 207). In the case of this study, the workshops, action research reports, and methods for investigation were all designed and delivered by university faculty. In keeping with this framework, outcomes of the study focus on unidirectional learning with university faculty defining the knowledge that is valuable, acting as designers and decision makers of the structure, and ultimately facilitators and holders of knowledge for teachers within the space.

These studies offer an illustration of two different approaches to teacher learning that highlight aspects of both process and outcome. In the first example (Yuan, Zhang, & Yu, 2018), teachers engaged in a collective struggle for defining, designing, and developing their learning

space leading to shifting structures and changes over time. At some points, teachers voiced discomfort and indicated moments when their work appeared directionless and inefficient. However, by working through this process together, the teachers ultimately grew into a collaborative group that met the needs of the whole. In refining this process for teacher learning, members of this group developed a sustainable community that could be continued indefinitely. In the second example (Wongsopawiro, D.S., Zwart, R.C., & van Driel, J.H., 2017), teachers participated in learning connected to a pre-determined design and structure developed by university-based faculty. Members of the group opted into participating in the year-long experience which offered resources, information, and expertise that extended beyond the walls of the school building. In this case the framework for learning was pre-determined by university-based faculty and points of struggle were defined based on how learning (the amount and type) aligned with university-based expectations within a finite period of time. In considering the benefits and drawbacks of these approaches, one might consider how combining elements of on-going learning, flexible structures for collaboration, with the presence of university-based and cross-school interactions might offer new and invigorating learning contexts for teachers.

Intergenerational Teacher Education Communities

When stepping back to look across this full body of literature, insights, opportunities, and gaps for thinking about intergenerational teacher education communities begin to emerge. Across the literature, researchers make clear the importance of fostering spaces for strong, reflective professional learning where teachers can continue to grow across the full life of their careers. Learning contexts such as the professional learning community described in the work of Yuan, Zhang, & Yu (2018) illustrate the importance of teacher autonomy as they make decisions that direct how a learning community can be created, refined, as it evolves over time. Teachers need

the latitude to make creative decisions that best foster these changes. In other similar studies, findings related to this kind of teacher learning are associated with "unexpected challenges" (Tirrell-Corbin & Cooper, 2014, p. 33), "unpredictability and structured disorder" (Hervas & Medina, 2020, p. 122), and "dissonance" (Rönnlund, Bergström, & Tieva, (2021), p. 597) as teachers work through real conflicts and dilemmas that are central to teaching practice. While these are situations that some might endeavor to avoid, the processes and outcomes of these spaces tend to be complex and also positive as all members participate in deep, thoughtful, and reflective work that aligns with developing teacher moves that benefit student learning (Willegems, Consuegra, Struyven, & Engels, 2018). This research does not offer easy answers but does present insights into the nature of teacher learning that highlights the inherent messiness of learning that is sometimes ignored.

This body of literature also highlighted the complex contexts for pre-service teacher learning. An exploration of this literature addressed the pre-service/in-service divide as researchers considered the relationships and learning that come from pre-service teachers' collaborative work in school spaces, especially in mentoring relationships with in-service teachers. When looking across these studies, they contribute to our understanding of approaches to learning and teaching on the side of the pre-service teacher and the mentor. At the same time, these studies focus mostly on learning structures that are hierarchical/uni-directional as researchers tended to limit their investigations to pre-service teacher learning *from* in-service teachers who were acting in a mentoring role and teacher educators supporting one or both of the other two groups (i.e., Campbell, & Dunleavy, 2016; Mena, Hennissen, & Loughran, 2017; McNew-Birren & van den Kieboom, 2017). Some studies also centered on learning of the mentor as they developed mentoring knowledges and skills with the mentoring situation acting

as a catalyst for learning (i.e., Helgevold, Næsheim - Bjørkvik, & Østrem, 2015) but these looked at mentor learning in isolation rather than considering it alongside that of the pre-service teachers. This formulation of learning structure assumes a pre-determined sequence and structure for generating and sharing ideas that suggests a dividing line of how and when someone is teaching versus learning. Based on definitions and research of community-based intergenerational learning, an opportunity exists to inquire into less hierarchical and more multi-directional structures of learning that assume dividing lines of learner and teacher that are more porous and less fixed.

Multiple studies in the corpus of literature investigated teacher learning meant to inform teaching practice. At the same time, most of these represented experiences that were built on a limited timeline with the most intensive experiences set for one academic school year. This approach meant that time became (Ukkonen-Mikkola & Varpanen, 2020) a factor that effected (and often limited) the learning that was happening. Teachers had the opportunity to learning in one cycle (Wongsopawiro, D.S., Zwart, R.C., & van Driel, J.H., 2017), one experience (Lefstein, & Perath, 2014), or one project (Sheridan, & Young, 2017). When comparing this to reflections of veteran teachers who talk about the ebbs and flows of their practice, these one-shot experiences compared to many years of teaching practice do not represent a large portion of a teacher's professional experience. Yet, teachers rarely have access to extensive, intensive learning spaces that make space for on-going experimentation. This is a gap in both research literature and experiences that teachers are able to access.

Chapter 3: Research Methodology

Every day, teachers around the world engage in complex interactions of learning and teaching. This is a process that, especially in a school setting, might seem obvious and even mundane. However, the constant assault, particularly in the United States, on teachers and the teaching profession threatens perceptions of and trust that is put in teachers, thereby calling into question their capacity to enact and enhance professional processes that are central to the teaching profession. With such a barrage of critique, it is imperative that we speak back using strategies that encourage further investigation and take into account equalizing factors that honor the work and voices of teachers.

The purpose of this study is to explore the complex array of participation, experience, creation, and learning that happen within an intergenerational teacher education community. This study provides one context for thinking and rethinking possibilities of teacher learning

Intergenerational Teacher Education Communities: Defining the Members

As discussed in Chapter 1, an intergenerational teacher education community is an environment where teachers (1) with varying levels of experience (generations) come together; (2) exchange ideas and generate new knowledge back and forth and between each other; (3) engage in group decision making that guides the work of the community; and (4) enact processes of creation that serve to move the vision and mission of the community forward.

This study provides opportunities to consider how learning *among* teachers might develop (rather than learning that is a result of education provided *to* teachers). Directionality of teacher learning is also central to this study, especially among (but not limited to) individuals who are members of the community. Learning that flows from more experienced teachers toward those who are less experienced is a traditional example of this directionality and is a sort of

learning that might be assumed. However, how might more complex movements of learning play out, especially when grounded in an assumption that every member of the community is both learning and teaching? How do those contributions change over the course of time as members of the community continue to participate as part of the group? Exploring the possibilities of these complex webs has the potential to uncover more robust and nuanced understandings of teacher learning and may also run counter to narratives that assume value in only formalized, hierarchical and/or external professional development as a means of ensuring the professional learning of teachers.

In the context of this study, teacher educators, who represent university-based teacher learning, add another aspect to the complex community structure. As illustrated in Chapter 2, teacher learning is often designed in ways that encourage isolated learning and/or implementation of what is being learned. Moreover, university involvement in teacher learning is most often designed in ways that positions university representatives as people who unidirectionally deliver knowledge or information to teachers in K-12 settings. The addition of a university community member who is seen as collaborator and coconspirator (rather than deliverer of knowledge) offers a prospect of adding another dimension to learning in the group as well as the potential to provide access to different resources and perspectives that might contribute to its aims. Membership of a teacher educator also provides a link or bridge to opportunities for pre-service teachers to participate in these professional spaces.

As a person whose primary affiliation is with a university, this framing was particularly relevant to me as I embarked on this project holding roles of both community member and researcher. My role of university partner within the community required an accounting for my own membership practices and the inclusion of strategies for deep reflection as I considered how

this dual role informed decisions that I made as a researcher. The framing of my role was also important because just as I am concerned with the story that can be told about intergenerational teacher education communities in ways that might *broadly* inform the work of others and contribute to existing literature, I am equally eager to find ways of telling these stories that might *locally* inform and raise up the work of the Citizen Scientist Curriculum Team. My hope is that sharing this story in both contexts acts as a small contribution to move the professional work of teachers forward in ways that lead to potential transformation that align with the visions and goals held by teachers as they learn and grow.

In keeping with this aim, this project uses principles of community-based research as a foundation for its design. This includes considerations of the role that I as the researcher played in the research process as well as the roles of my fellow community members who agreed to participate in the study. To that end, it was vital to think about how this research might inform and align with the ongoing design, purpose and priorities that had been taken up by the Citizen Scientist Curriculum Team especially in relation to the generative aims of the group that would continue far beyond the life of this specific study (Johnson, 2017). This assumes a responsibility that aligns with the transformative activist stance – a stance connected specifically with Vygotskian thought that emphasizes activist components as elements of the project of research and highlights the responsibility of the researcher to use what is created not just for the purpose of contributing to the academy but also in informing change in the world (Stetsenko, 2017). In saying this, I do not mean to imply that by conducting this study I intended to enter any community with the intent of being the actor who transformed them, their work, or visions of work that they had already established. Rather, it was my hope that the production of research about our shared community efforts would represent one of my contributions to the group just as

the work of other community members represented their contributions to our efforts. However, this strategy could only be viable if I was situated as not only researcher, but also member of the intergenerational teacher education community that I would study.

Participants

The purpose of this study was to closely examine the workings of an intergenerational teacher education community, defined using the criteria noted above. To achieve this aim, I employed a purposeful sampling method (Bogdan & Biklin, 2007) to "choose particular subjects to include" that would ideally "facilitate the expansion of the developing theory" within the study (p. 73). In this instance, I wanted to investigate not just *any* professional learning but the specific learning that happens as teachers act as members of an intergenerational teacher education community.

The inspiration for this study originated from collaborative work I was already engaged in alongside members of the Citizen Scientist Curriculum Team. This group represents only one example and possibility for enacting the work of an intergenerational teacher education community, but insights drawn from this instance can be used to inform principles of practice in other contexts. The group was immersed in processes of teaching and learning that met the basic criteria of an intergenerational teacher education community, making them an ideal community to study. The collaborative work of the group was something that I had rarely seen in other contexts, and all members seemed to be invigorated by the experience. I was curious about why so many generative ideas were emerging from this group and had questions about what made the community work.

Before discussing the possibility of studying the community with anyone else, I first introduced the idea to the Citizen Scientist Curriculum Team. I wanted to be certain that they

would feel comfortable with our work being investigated in this way. As a group, we had already been talking about finding ways to tell our story, so the conversation was not one that was outside the realm of the group's current priorities. From the beginning, the members of the Citizen Scientist Curriculum Team enthusiastically supported the project. With their support, I developed a plan for research and, using principles of community-based research, asked for members' input about the approach and design of the study as I went.

A profile of the Citizen Scientist Curriculum Team is shown in Table 3.1. The community included teachers with varying levels of experience (0 to 20 years) as well as members who held other roles: a university-based teacher educator (me), and a high school student. Membership within the Citizen Scientist Curriculum Team grew from year-to-year as is also illustrated in the table with notations of when members of the group joined the team. As participants of the study, members of the Citizen Scientist Curriculum Team continued enacting the regular activities of the community. All members actively collaborated to develop a shared project that included multifaceted goals even as everyone contributed to the work and learning that happened as a result of working toward those aims.

For purposes of this research, members of the Citizen Scientist Curriculum Team participated in interviews, focus groups, follow-ups, and agreed to be recorded during regularly scheduled meetings. In addition, the group individually and collectively spent time discussing patterns I noticed emerging from the data. This often happened in at times when we were already meeting for other reasons. The conversations resulted in members adding to, clarifying, and refining ideas that came from my preliminary analysis. Finally, as the project was coming to a close, some members of the community read portions of or the full body of work and met with me to make comments, offer feedback, and share perspectives regarding the findings.

Table 3.1: Citizen Scientist Curriculum Team Member Profiles

Team Member	Race/ Ethnicity[1]	Years of Experience[2]	First Year of Participation[3]	Membership Role(s)[4]	Teacher Certification[5]
Alex	Latino	4	2017	Teacher	Students w Disabilities
Dan	White	0	2019	Teacher	TESOL
David	Multiracial, Filipino and Jewish	2	2018	Teacher	Students w Disabilities
Imani	Multiracial, Identifies as Black	1	2018	Teacher	TESOL
Katherine	White	17	2017	Teacher	TESOL/ELA
Lauren	White	7	2017	Teacher	Science (Biology)
Marisol	Hispanic American	4	2019	Teacher	Science (Biology)
Michael	White	0	2017	Teacher	Science (Biology)
Riko	Japanese American	0	2019	Teacher	Science (Biology)
Torben	African American and German	1	2019	Teacher	Science (Biology)
Victor	Afro Indigenous Latino	-	2018	High School Student	-

Note: [1] Rather than using a fixed set of categories, race/ethnicity was self-described by each participant. [2] Reported as the number of years teaching as a certified classroom teacher at the time each participant joined the Citizen Scientist Curriculum Team. Members who joined the team immediately following graduation are noted having zero years teaching. [3] Reports the first year of participation on the Citizen Scientist Curriculum Team. Dan and Riko collaborated with the team as pre-service teachers in 2018 and became members of the team in 2019. [4] Victor was a high school student until he graduated in 2020. Following graduation, he continued to participate on the Citizen Scientist Curriculum Team as an undergraduate student. Dan and Riko were first affiliated with the Citizen Scientist Curriculum Team as pre-service teachers but joined as members in the following year when they were certified teachers. [5] All teachers held certifications in grades 7-12. Teaching English to Speakers of Other Languages (TESOL) certifications were in grades K-12.

In addition to the Citizen Scientist Curriculum Team, other individuals were involved in the programming that was designed and implemented by the community. This included the Citizen Scientist Instructional Team, a group of teachers who did not have the bandwidth to participate in the team's fall/spring meetings but wanted to be part of the implementation of what was designed. High school students were also participants of the programming that emerged

from the work of the Citizen Scientist Curriculum Team. While these individuals were not centrally involved in this study and were not part of interviews, focus groups, or other targeted data collection, the experiences of these individuals connected back to the learning, experiences, and activities of the Citizen Scientist Curriculum Team and made up a wider community of people who impacted the work, learning and teaching of the team but were not inside the scope of the study.

Research Design

This project is designed to be a qualitative community-based study that uses reciprocal ethnographic data collection and analysis techniques to better understand the dynamic, experiences, learning, and growth of one intergenerational teacher education community, the Citizen Scientist Curriculum Team. The approach and purpose of community-based studies varies based on the situation and context. Most often, community-based research is designed in a way that emphasizes a problem or issue that is faced by the community, meaning that the study is centered (i.e., decisions are made and research is guided) in the community but the research itself *faces outward and is directed toward an external issue* that the community is experiencing (e.g., a community-based study that focuses on understanding the impact of housing issues on a local neighborhood that is conducted collaboratively with university and community representatives (Speer & Christens, 2012)). This study differs from that more typical approach because the focus *points inward and is directed toward understanding the internal dynamic* of the intergenerational teacher education community as a group that is engaging and developing together. This means that this research centers (i.e., decisions were made, and research was guided) in the community, is inward facing, and is directed toward the community itself. In this particular situation, these inward-focused aims still maintained their potential to positively

benefit the community because a central norm of the group is to seek strategies to refine reflection on practice, enhance collaborative efforts between members, and justify the time and efforts of this work to administrators and other teachers. The findings of this study inform the work of this group in each of these areas.

Because it is community-based, by necessity the nature of this study was designed with integral collaborative components, including dialogue and decision making with community members. In a setting such as this, it was important for me as the researcher to engage as a contributing member of the community and as a partner who bears the same responsibilities of reciprocity and collaboration as other members. The benefit of this strategy of engaged scholarship was that it centered the design, analysis, and dissemination of research in ways that addressed my own individual goals as well as the interests, needs, and priorities of the community as a whole. However, my position also inevitably presented challenges related to the multiple roles that I inhabited within the community (Johnson, 2017). To address these concerns, I incorporated follow-up and reflection cycles where I brought my work back to members of the group (sometimes collectively and other times individually) to discuss, reflect, refine, and clarify the work I was doing. Not every aspect of this study could be shared, for example, this project was developed as research for my dissertation, which meant that it could not be conceived as a co-authored piece. At the same time these collaborative practices offered a layer of dialogue that in at least some ways addressed relationships of power between participants and research. In this context, members of the Citizen Scientist Curriculum Team acted as consultants, coconspirators, and contributors to this work throughout the process. This practice is in keeping with tenets of reciprocal ethnography which prioritizes:

> [D]eep listening to people we respect and honor as equal participants in our work reveal[ing] a different kind of knowledge building based on long-term ethnography. We

> have aligned ourselves with them, working to help them to locate a space to tell their story, to speak their truth, even as they seek those who are willing to listen. (Lawless, 2019, p. 6)

Community-based research is designed to be transformative in nature as projects aim to "have an impact on perspectives and practices of research group members" (Johnson, 2017, p. 17) for all members of the community *including* me as a researcher. Approaching this project in a way where I challenged myself to be open to and invite change was integral in identifying potential bias and also in refining my ability to pause and focus on listening deeply.

As stated earlier, qualitative community-based research is an approach that urges an approach with an eye toward action-oriented outcomes that include the possibility of generating ways to apply research findings to contribute to the community in order to generate resources, improve conditions, and/or move projects forward that are central to the group's mission and vision (Johnson, 2017). In keeping with this, an aspect of this research included considerations of sustainability following the conclusion of the study. Our aim was to ask ourselves: How might the Citizen Scientist Curriculum Team continue to engage in similar processes of data collection, analysis, and reflection as part of our work? How can we use the findings of this study as information to share with wider audiences? What audiences should we prioritize (and to what end) as we seek to disseminate these experiences beyond our localized groups? These are questions that inform my own on-going research process and also the continuing priorities, projects, and aims of the Citizen Scientist Curriculum Team.

Components of Quality Community-Based Research

Three principles that guide qualitative community-based research are that it (1) recognizes communities as intellectual spaces; (2) attempts to generate praxis; and (3) encourages engaged learning. Three core elements are drawn from those principles and must be

present in developing a framework for engaging in qualitative community-based research. These are that it (1) is collaborative in nature; (2) employs a critical stance; and (3) seeks to generate transformation. Each of these aspects (both principles and elements) are considered in the design, data collection, analysis, and dissemination of community-based research (Johnson, 2017).

Principles of Quality Community-Based Research. Principles that provide a foundation for community-based research prioritize the nature of the relationship that is developed with the community as well as the orientation of researcher as a learner. In this approach, the researcher is defined not only as me (the person who is taking on the primary role of initiating and generating this project) but also members of the community who agree to also engage in dialogue and processes of decision making that are related to the research itself (Johnson, 2017).

Community as an Intellectual Space. The principle of community as an intellectual space is tied to ideas such as funds of knowledge (González, Moll and Amanti, 2006), intentional development of counter narratives (Rinaldo, 2002; Solórzano & Bernal, 2001), and critical social intelligence (Dewey, 1935). This approach seeks "to build upon the unique capabilities, history, culture, and lived experiences in local settings, with the understanding that problems must be articulated, and solutions made workable, within the lived experience of actual communities" (Molina & Bishop, 2005, p. 1). Within a qualitative community-based research framework, this necessitates that community members be positioned as key contributors who are able to most sensitively inform and guide research (Johnson, 2017).

In the case of my own research, this meant that the involvement of members of the Citizen Scientist Curriculum Team had to go beyond passive, uninformed participation in the study. Instead, my intention was to make the process as dialogic as possible (Lawless, 2019;

Johnson, 2017). These actions and considerations helped to reposition community members as people who not only informed my understandings related to a pre-defined research agenda but also situated them as active contributors to the research process itself, enabling a deeper perspective that I would not have been able to generate on my own. In doing this, I was also constantly aware of the fine line I was walking of asking members of the group for too much of their time as they juggled jobs, family and other personal responsibilities, and their membership as part of the Citizen Scientist Curriculum Team. In an effort to offer balance, I offered invitations for participation in conversations but did not push when members said they did not have time in their schedules.

Engaged Learning. Engaged learning positions qualitative community-based research as a practice of learning that is both active and experiential. For researchers, this means taking up a learning theory lens that emphasizes experiential immersion as a strategy for best coming to understand a given context, process, or circumstance. "Within engaged learning, learners are viewed not as passive consumers of information but as active participants in creating new knowledge" (Johnson, 2017, p. 17). This connects general principles that we know about teacher learning: that it is socially situated (Vygotsky, 1980; Wenger, 1998), is informed by experience (Dewey, 1916; Klkajaer, 2009), and that expertise leads to deeper and deeper cycles of learning (Peercy, Martin-Beltran, Silverman, & Daniel, 2015).

For me, thinking about research as an act (as opposed to an act of knowing) meant approaching this project with permission to be imperfect and curious. This was especially important to me as I felt pressure to be perfectly intentional, systematic, and consistent in each aspect of my research process. I worried about finding nothing significant from the mountains of data that I was collecting. In actively considering a stance of engaged learning, I was able to take

a breath and approach this study from a position of learning where I expected to sometimes be lost and uncertain but also looking toward a hope of walking away with something that might inform my own practice as well as that of others. In addition to my own learning, as we worked together on this project, we came to develop new understandings of our community dynamic that informed our thinking as we worked to move ahead with the work of the group.

Praxis. The idea of praxis**,** was introduced by Aristotle as "practical knowledge with the end goal being action" (Johnson, 2017, p. 15) and was refined by Paulo Freire adding an emphasis of praxis as a liberatory act. In applying praxis to the framework of qualitative community-based research, one must "not just identify or describe social problems but also become actively involved in challenging existing conditions and 'speaking back' to inequities and injustice" (Johnson, 2017, p. 15). By nature, this requires that researchers are actively involved in the communities where they work and are considering both descriptive elements of the research process and also accounting for potential steps of action or dissemination of findings that may inform the priorities and vision of the community.Intergenerational teacher education communities serve as spaces where teachers are able to come together to generate strategies for more effectively supporting their own growth and development and, in turn, the learning experiences of their students. Taking into account this process of teacher learning as a central and professional act in itself is an action that speaks back to assumptions about the nature of teaching. In turn, this approach is a starting point (not the only starting point, just one) for addressing issues of access experienced by students, especially in high-need urban contexts, to teachers who are well-prepared, are continuing their development, and are able to support the learning of students. As members of the Citizen Scientist Curriculum Team seek to enhance their practice by continuing in these aims, the objective of this research was to align the design so that

goals can be highlighted to inform the continued work of the group. For example, the process of this project initiated explicit conversations about the norms of the group leading to new insights regarding topics such as trust, vulnerability, and risk taking within the group. These conversations directly impacted ways that we conceptualized the work that we did with pre-service teachers and high school students in the following summer.

Elements of Qualitative Community-Based Research. While approaches to qualitative community-based research can vary substantially based on situation and intent, three common elements act as defining factors for this type of research and serve as guideposts in thinking about its design.

Collaborative. Collaboration is a key element of qualitative community-based research with the researcher engaging in constant dialogue and discussion with the community and accounting for varied perspectives that are used to inform research design. As projects are designed, considerations of authority and hierarchy should be considered. In such projects, members of the community should be positioned as partners in the research, representatives who have valuable ideas, understandings, and knowledge to offer across the many dimensions of the study (Johnson, 2017).By definition, collaboration is an integral thread of an intergenerational teacher education community, making it even more important to account for this element of qualitative community-based research. In practice, the design of this study incorporated processes of collaboration including built-in opportunities for both community and personal reflection on how our interactions were playing out and how perspectives of all were being taken into account. Since it was directly associated with my personal work, I inevitably filled the role of initiator and driver of the study. In this role, my attention and priorities differed from other members of the group who were fully aware of my research, were happy to contribute, and were

generous with their time as we discussed portions of the project. Because of the personal reasons for the study, my motivation in completing it far outweighed that of other members of the group. At the same time, *all* members were similarly motivated to continue their membership for various reasons that aligned with each person's priority for participation. When considering the complex entanglement of priorities, needs, and strengths among members of the group this study represented only one small outcome among a much larger lattice of initiatives.

Critical. Qualitative community-based research should be designed to investigate ideas in ways that seek to look beyond a simplistic explanation and instead encourage explorations that account for multiple stances and multifaceted perspectives. This includes endeavors to examine narratives that challenge the status quo as well as attempts to "connect what is happening in local communities to larger societal conditions, broader policies, global events, and historical shifts impact[ing] conditions and resources available to community residents" (Johnson, 2017, p. 17).For me, engaging in critical considerations and looking beyond simplistic explanations was bound in the details of the research process itself. For this study, three components that pushed my understanding and explanations beyond the simplistic were (1) frequent reflections in the Citizen Scientist Curriculum Team to consider our own experiences in the research process as well as the data that is being collected; (2) frequent reflections on my part both individually and also conversations with two critical friends that were meant to push me to challenge and expand ways that I am making sense of the data that I was seeing; and (3) constant analysis and reanalysis of the data that is being collected.

Transformative. By nature, the aim of qualitative community-based research is to act as a tool that can be used to facilitate change and improvement that is meant to be grounded in local community and is also intended to have a broader impact. This includes considerations of how

the research process might change the perspectives and practices of members of the research group. It also assumes a stance that "learning and teaching should occur as part of a bidirectional process, where all research group participants are viewed as capable of both sharing expertise and acquiring new knowledge and skills" (Johnson, 2017, p. 17). In engaging in transformation, this element also assumes a responsibility to incorporate action into the process of research.

As stated before, this project was meant to be the first of multiple projects focused on the work of the Citizen Scientist Curriculum Team. One difference between this and future projects is authorship as the group aspires to co-author studies about the learning that is connected to the group. As a pilot-of-sorts for a broader research agenda, this project has led to new thinking and opportunities for the group that offer next steps and new considerations for all members.

Data Collection

The primary purpose of this study was to further investigate the development, dynamics, and learning happening in one intergenerational teacher education community. In collecting data for this project, I used collection methods meant to capture the work of the collective group and others to capture the perspectives of individual members. Collecting data from both of these angles was important because it gave me a chance to consider exchanges, supports, and interactions of the team as a whole while also better understanding the thinking, intentions, and experiences of individuals.

Another element that drastically impacted the data that was collected for this study was COVID-19. The nature of the work of the Citizen Scientist Curriculum Team drastically changed in 2020 and 2021 impacting the nature of the data that was collected. Because of this circumstance, some data that I had planned to collect (e.g., extensive fieldnotes on in-person interactions between group members) were much more abbreviated than expected simply

because we did not meet as regularly and when we did for much shorter periods of time. This situation caused me to rely more heavily on documents, materials, and resources that the team had archived as well as individual and focus group interviews about the work of the team.

Data collection methods for this study included:

- **Artifacts and Documents**. Documents and artifacts created by members of the Citizen Scientist Curriculum Team became a key source of data for this study. In my initial planning, I had anticipated going through these documents, but did not predict that they would end up playing such a key role in the study. Artifacts included documents such as meeting notes, curriculum materials, project plans, and a range of other miscellaneous items. They also included a trove of video and audio recordings, photographs, and other materials that became invaluable for my work, especially as I began to backward map the sequence of events that led to the inception of the team.
- **Individual Interviews.** Each member of the Citizen Scientist Curriculum team participated in individual interviews that offered an opportunity to develop a better understanding of how each members' individual experiences mapped onto the work of the group as a whole. The interview process included cycles of conversation that, for each individual, started with one formal interview and then was followed by formal and informal follow-up conversations.
- **Focus Group Interviews.** Members of the Citizen Scientist Curriculum Team participated in multiple focus group interviews over the course of the study. By design, "the basic purpose of the 'focused' interview [is] to gather qualitative data from individuals who have experienced some 'particular concrete situation,' which serves as the focus of the interview (Stewart & Shamdasani, 2015). In the case of this study, focus group interviews ended up being enacted in ways that were much more informal than I had initially envisioned and often

were integrated or "tacked on" to meetings that were already happening. Like the individual interviews, these focus group interviews went through cycles of conversation that included follow-ups when new questions from what was discussed emerged.

- **Follow-Ups and Informal Conversations.** Some of the most (unpredictably) insightful data that was collected for this study came from follow-ups and informal conversations that were initiated following more formal interviews. These conversations were used as a way for me to check my interpretations of what members of the group were saying as I went through the individual and focus group interviews and to develop a sense of how experiences between members of the group aligned. For example, in interviews with Katherine and Marisol, both offered extensive insights into their motivations for participating on the team. In reflecting on their statements, I wondered about the motivations of other members of the group and subsequently followed up with them to learn more. Likewise, in a focus group with Michael, Riko, and Katherine, Michael asked a question about how work on the Citizen Scientist Curriculum Team had pushed our boundaries. After this conversation, I followed up with other members of the group to ask them their perspective on this question.
- **Participant Observation.** The term *participant observation* is used broadly to describe a range of research methods. In using this terms, I am describing the process of collecting data that is "founded on firsthand experience in naturally occurring events" (Wolcott, 2008, p. 49). In this case, this study involved my own membership and actions as part of the Citizen Scientist Curriculum Team as well as fieldnotes and reflections that captured my observations and responses to what I saw, heard, and thought while observing the work and interactions that were connected to the group. These observations happened most often during meetings with the group.

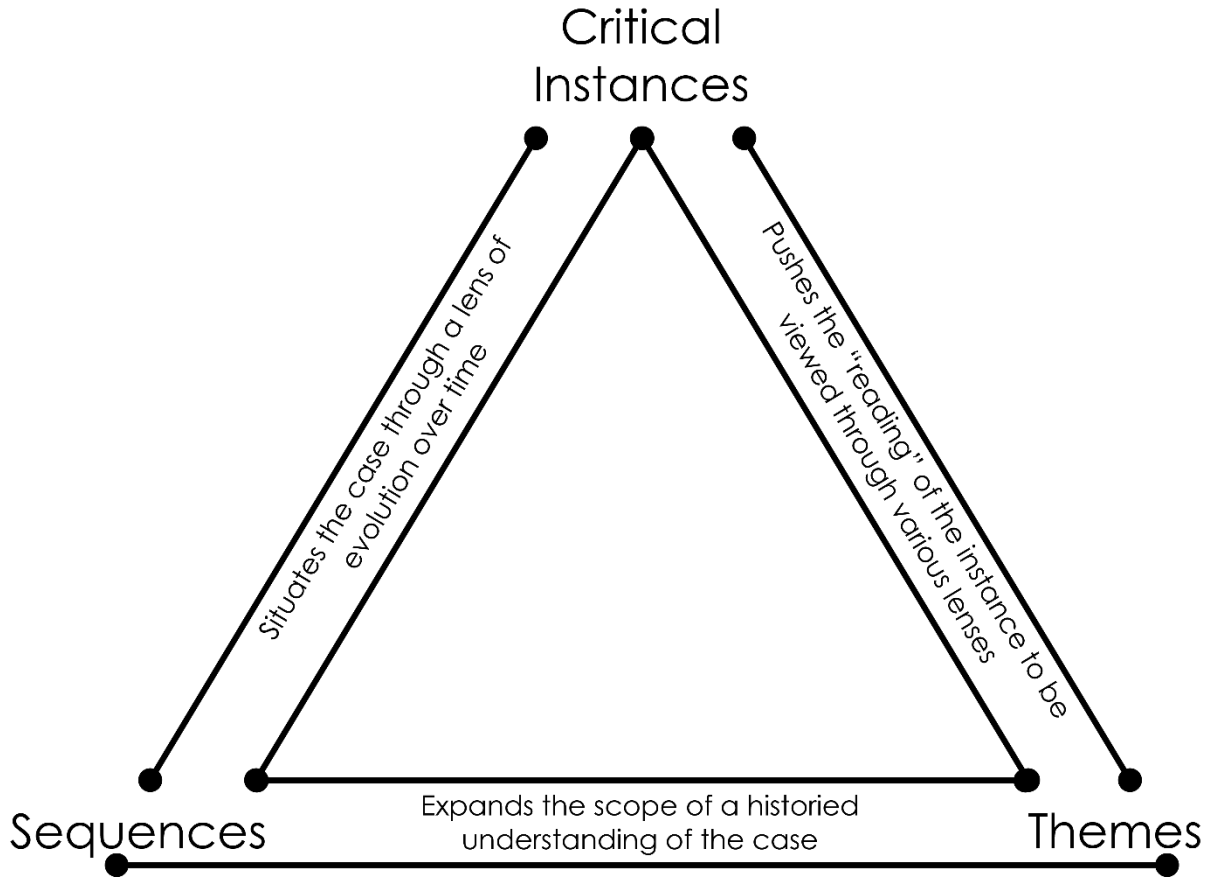
- **Reflective Memos and Conversations.** As a member of this community, it was especially important for me to regularly reflect on and consider the tension between the roles that I held in this community. I was constantly thinking about this dual-position and how it affected the lenses through which I was making sense of what was happening. I recorded these thoughts, reflections, and ideas in written and audio memos. I also discussed my thoughts with other members of the Citizen Scientist Curriculum Team. These discussions were most often one-on-one conversations with individual team members. These conversations were sometimes recorded as memos, other times I jotted notes as we talked.

Data Analysis

Data for this project were analyzed sequentially, thematically, and through examination of critical instances. These types of analysis were used cyclically to build layers of understanding as I sifted through data and attempted to pull patterns and meaning out of what I was seeing, like an analysis lasagna. Each layer offered a different dimension of understanding that enhanced the complexity of "flavor" within the analysis. Figure 3.1 illustrates how each analytical feature informed the other.

Analyzing Data Sequentially. In analyzing the data sequentially, I considered analytical questions that focused on the evolution of the Citizen Scientist Curriculum Team. I looked at what was different and how things changed over the course of time and used these observations to identify potential areas that seemed to be a priority for the group (Saldaña, 2003). Sequential analysis also offered insight into "forgotten" moments that were not discussed in other forums but when tracing through the history of the program they emerged as potentially important. This allowed me to then follow-up with team members to explore their significance.

Figure 3.1 Elements of Data Analysis



Note. The figure illustrates the relationship between each data analysis strategy with each approach informing and enhancing the other.

In enacting cycles of sequential analysis, this process was also informed by cycles of thematic and critical instance analysis. For example, it was through my thematic analysis that I realized the scope of my sequence needed to extend back to include aspects of the origin of the Citizen Scientist Curriculum Team that pre-dated the actual formation of the group in order for some actions and decisions to make sense.

Analyzing Data Thematically. Data were coded and analyzed based on emerging themes that came from recorded exchanges, discussions, and interviews. I started my thematic analysis with an initial cycle of descriptive coding that led to the identification of main ideas and potential patterns within the data (Saldaña, 2021). This was followed by a subsequent cycle

where I clustered descriptive codes and used these to identify initial themes (Saldaña, 2021; 2003). These were then used to formulate analytic questions that informed subsequent readings of the data and led to an endeavor to match intent that was described in conversation with actions (both consistent and changing) that could be observed in a variety of contexts. These themes were integral as I made decisions about which exchanges and experiences might matter most as I selected stories that would be analyzed as critical instances. The emerging themes also affected my interpretation of artifacts, documents, observations, and conversations that contributed to the sequential storytelling of the group's evolution

Analyzing Data Through Examination of Critical Instances. For me, stories have always been powerful tools for learning. They have the potential to offer nuance, specificity, and intimacy as the reader gains familiarity with individuals in their given context, instance, or situation. They also grant the reader flexibility in making imaginative decisions as they consider potential possibilities for applying the principles that are being illustrated. The purpose of my analysis of critical instances was to offer a more zoomed in look at moments that seemed to illustrate critical components of the work of the Citizen Scientist Curriculum Team. This was a particularly helpful analytical tool for me because it offered an opportunity for me to talk more transparently about my own experience and responses to things that were happening at given moments in time. I analyzed these instances using two cycles of reflections: real time and stopping time (Ballenger, 2009). In the first cycle, real time, the analysis is "analogous to the experience of being there" (p. 11). In this cycle, I went through the transcript of each critical instance and annotated it with my own responses, thoughts, concerns, and ideas that I was experiencing at the time. The next cycle, stopping time, "is the cycle of reflection" (p. 11). In this cycle—which ended up being represented by multiple drafts and iterations of reflection—I

offered an interpretation of the instance. Developing these critical instances was an opportunity to more deeply investigate the intricacies of the nuance, norms, rhythms, and routines that were enacted by the Citizen Scientist Curriculum Team. It reinforced patterns that I was identifying in the thematic analysis and offered a space for more intensive examination within the broader evolution of the team.

Trustworthiness

In this study, trustworthiness needed to account for my transparency to the members of the Citizen Scientist Curriculum Team as well as to the research. Because of this, my considerations of trustworthiness were designed with both in mind.

Transparency to the Citizen Scientist Curriculum Team. In the course of this research, I regularly engaged in dialogue about aspects of the study with the group members. This included times when we reviewed large and small portions of the study – sometimes as a full/small group and, at other times, individually. These conversations offered an opportunity for members to review, revise, refine, clarify, and contribute their perspectives to work in process. As a final step to this project, I invited all members of the group to read a penultimate draft of the manuscript and then set up a time when we could discuss what I had written, again, with an eye toward revision, refining, and clarification.

Critical Friends. As a member of the Citizen Scientist Community Team, I have the benefit of an insider perspective to the group and also knew that there could be a danger of my own bias limiting my vision and understanding of what was happening within the group. In an effort to check my own biases, I worked with a critical friend who acted as a sounding board for my own ideas and thoughts. These conversations acted as an opportunity to consider the work I was doing from an outside context. In this role, my critical friend was able to ask questions and

offer suggestions that helped to temper overzealous conclusion jumping and push my own ideas in new and helpful directions.

Triangulation. The wide-range of data being collected acted as a third element to support trustworthiness in the study. In collecting data for this study, I acquired a mountain of material that I was able to use to examine emerging patterns in a variety of ways. This offered an opportunity to reflect on overlapping clusters of data that came from multiple sources and data types as a way of building patterns that robust and grounded in the work of the group

Limitations

Despite the often-linear published accounting of research studies, it's been my experience that the process of research is rarely predictable and often comes with surprises and problems that were unanticipated. When I prepared to begin the process of collecting data for this study in the fall of 2019, global pandemic did not exactly fit within the realm of problems and pitfalls that I predicted. For a study that was primarily focused on exploring the continued development of a team that did its work by sitting together around a table in close proximity, sharing meals, and spending long hours in intensive conversation surrounded by chart paper, sticky notes and supplies, it seemed that there was little choice but to put the study on hold and wait out the pandemic. At the time, it seemed like the world was going to stand still as we sat in isolation, and so would my study. But the world kept on going. As days turned to weeks and weeks to months, I watched and listened to teachers and students exhausted by worry, isolation, and inactivity. In my small apartment, I worked to troubleshoot a seemingly never-ending stream of problems related to the residency program, remaking curriculum, replanning programming, and supporting pre-service teachers who were attempting to earn a degree in an already rigorous graduate program in "these unprecedented times." The truth is that I have very little memory of most of 2020 and

2021, most of it is little more than a blur of late-night course development and early morning emails with more work stuffed in between.

One thing I do remember is that by the summer of 2020, it had become clear that the approach to my study would need to pivot, just as the world around me had, if it was going to happen anytime in the near future. I can be stubborn and if it had been helpful to wait to begin, I would have. Initiating data collection in the summer of 2020 meant a fundamental shift in the ways I thought about data collection and a change in what kinds of data I would and would not be able to collect. For example, in its original form, most of the data I intended to collect would have been through field notes that were geared toward capturing exchanges and interactions of the Citizen Scientist Curriculum Team. I wanted to map out the group's meeting rhythms as we moved in a matter of seconds from intense conversation to lighthearted banter, the moments when one comment in the full group could instantly cause several side-conversations around the table and then just as quickly re-center back to conversation as a full group, and our tendency to cycle through ideas – revisiting conversations and plans to reflect on how to refine the ideas. These practices happened far less frequently (or visibly) as we shifted our work to an online platform. Meetings tended to be abbreviated, formal, focused on logistics, and stuck to points on the agenda. While our previous work happened only while sitting around the table (once we left the room, we moved on to think about other responsibilities and rarely did any work related to initiatives being planned by the team), now work tended to happen in ways that were less collaborative, individually, and after meetings had ended. These changes are significant when thinking about the limitations of this study. They required a pivot in my approach to talking about the group and required that my data collection and analysis be less focused on the day-to-day actions of the group and more on the broad strokes and the reasons for continuing the work

in the first place, even at a time when it might feel less rewarding. This also meant that I relied much more heavily on archived materials that had been collected by the group than I had initially envisioned and less on fieldnotes taken in real time.

At the same time, there are not many stresses that could test the mettle of a group—their ability to flexibly problem solve and creatively take on new challenges—as thoroughly as a worldwide pandemic. I don't think I would have ever imagined the enormity of the group's capacity to enact pivots in the product, but not purpose, of their work. This included an intensive three-week experience that was purposely grounded in in-person planning and outdoor fieldwork toward a fully virtual experience that was, in essence, a grand experiment in remote project-based learning. If, as a team, we could design and develop a three-week student experience complete with courses on solar engineering, the science behind fermentation (cooking included), home gardening, computer programming, entrepreneurialism, activism, self-care, and domestic water quality—all while providing the physical supplies to students and teachers needed for instruction—then there had to be a way to tell the story of why and how it happened. This study is my attempt to tell that story. Yes, the vision of my original study has still been put on hold, but with pivots and shifts, this study is meant to capture the experiences of the Citizen Scientist Curriculum Team through a lens of shifting priorities and needs at a time when the team—and the world—were put under extreme strain.

Researchers maintain a variety of perspectives regarding the appropriate proximity that should be maintained between researchers and participants. Some research methods require that researchers remain objective and aloof from those who they are studying, while other methods problematize a researchers' ability for objectivity. By definition a qualitative community-based research approach requires that the researcher ideally engage as a member of the community that

is being studied. While this has many benefits, it also limits a researcher's ability to see the unseen as might be possible from someone filling the role of only observer. This lack of unfamiliarity could be seen as a limitation and pitfall was important to keep in mind over the course of the research. Finally, the scope of this study could be seen by some readers as a limitation. By studying only one intergenerational teacher education community, it is possible to read this study as a program evaluation or ideal congratulatory example of practice that lacks relevance in other contexts. I hope that in writing this, it offers enough of a mirror into others' experiences that it can inform ideas for enhancing the important that others are doing in their own contexts by taking up the lessons learned, and principles practiced in this specific instance.

Chapter 4: The Case of the Citizen Scientist Curriculum Team

For a quarter of a century, researchers and experts studying teacher learning have been underscoring the importance of rich, meaningful teacher learning opportunities as fundamental to ensure high-quality student learning (see for example, Borko, 2004; Darling-Hammond & Richardson, 2009; Evans, 2024; Ghousseini, et al. 2021; Tekkumru Kisa, & Stein, 2014; and Stein, Smith, & Silver, 1999). Findings continue to push against paradigms of teacher learning that are designed as "transmissive with knowledge passed from one person to another" (Fütterer, et. al. 2024, p. 2) in contexts where "[t]eacher educators take more active roles and teachers more passive roles, and teachers mostly learn alone instead of in a community" (p. 2). Despite the mountain of strong evidence encouraging a shift in paradigm toward sustained and collaborative learning for teachers, too often these are not the kinds of opportunities they experience.

I was discussing this dilemma with a veteran teacher colleague one day and she joked that her own more common experience of formal professional learning was walking into a mandated workshop titled *How to Enhance Instruction by Not Using PowerPoint Presentations* and spending the next 45 minutes half-heartedly watching PowerPoint presentation slides as the presenter talks about why they should be avoided. The intergenerational teacher education community at the center of this study offers one example of teachers engaged in learning that is quite different from what my friend described. This was grounded in a mutual experience of learning that was interwoven with collective pedagogical tasks shared by the community.

The main *experience of learning* for the community emphasized pedagogical experimentation as we engaged in theoretical conversations and then concrete attempts at enacting ideas related to teaching and learning. In this context we were asking ourselves questions such as: *What happens when teacher learning is structured to mirror principles that we*

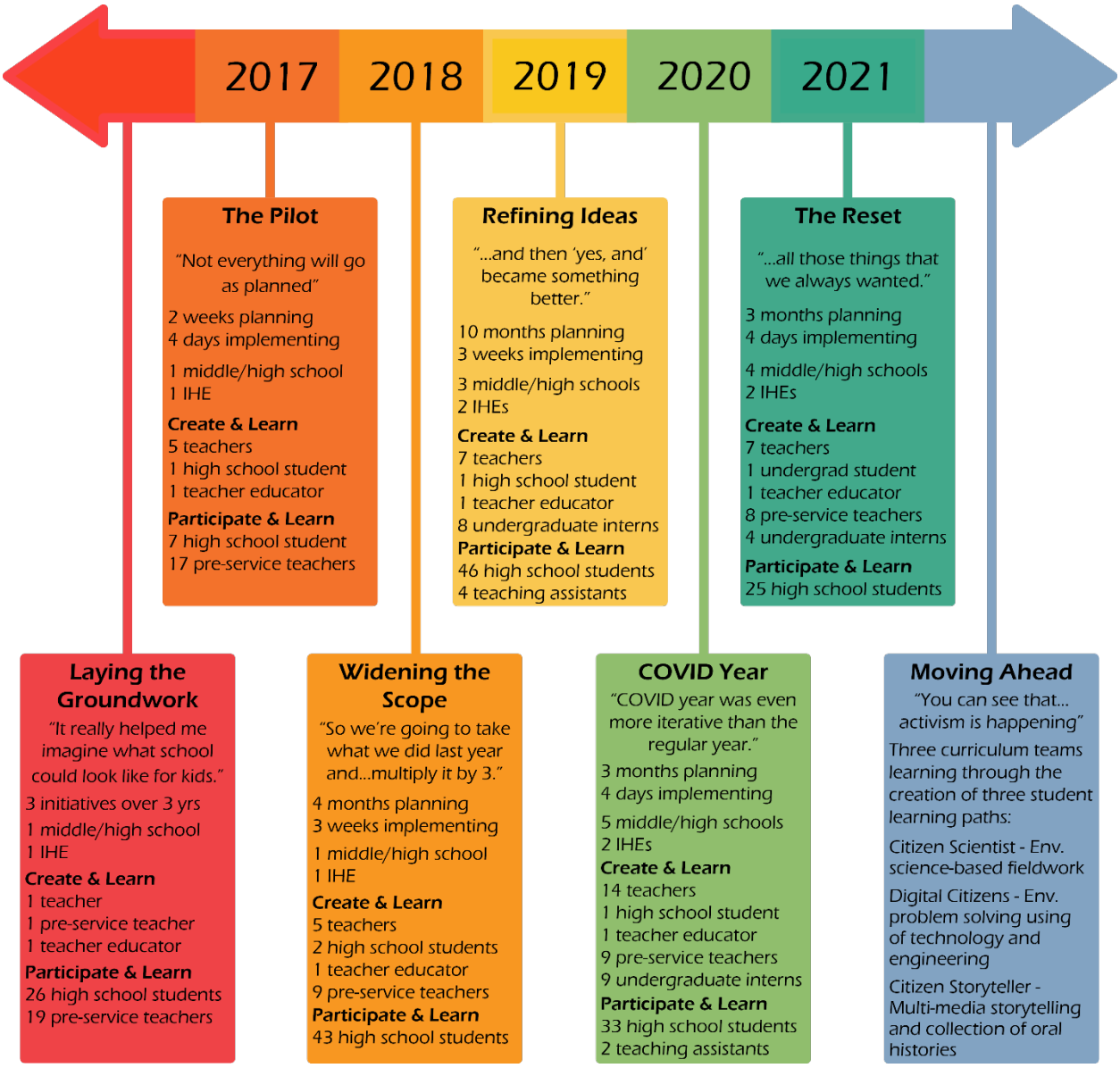
know are fundamental to the ways that students learn? How might we create our own space for teachers to participate as learners as we work to refine our own practice? What happens when our learning is grounded in sustained cycles of teacher learning that allow for collaborative experimentation, reflection, and modification? Where do collective opportunities for revision and iteration fit into our learning? These questions acted as drivers for the design and development of the community.

At the same time, the main *task* of the Citizen Scientist Curriculum Team was to develop hands-on, project-based learning opportunities that were experienced by high school students and pre-service teachers. These were intentionally designed in ways that *leaned into* the possibilities for learning that we all believed could come from attending to principles of inquiry-, and project-based learning as we developed and refined our own understandings and abilities to facilitate experiences that align with these approaches and contexts for learning. Our work in these areas led to the development of more sophisticated conceptions of collaboration and structurally flatter and more complex understandings of the nature of learning that informed our thinking about the possibilities for creating opportunities to explore new ideas in community.

The group centered in this study is the Citizen Scientist Curriculum Team, a collective primarily made up of teachers who came to the work offering a range of expertise in a variety of areas and varying degrees of teaching experience. Other members of the team included a teacher educator (myself) and a high school (eventually undergraduate) student. The community was not intentionally created and did not appear one day fully formed. Rather, it emerged out of a series of smaller experiences and once established, continued to evolve over the course of time. The roots and (often unpredictable) early pathways that led to formation and development of the

Citizen Scientist Curriculum Team offer insight into the growth and change of a teacher learning space where members were engaged in experiences of individual and collective learning.

Figure 4.1 Citizen Scientist Sequential Overview



Note: Timeline-overview of the teacher learning projects related to this case study and the work of the Citizen Scientist Curriculum team. Individuals listed in Create & Learn sections were those who participated as members of the curriculum and instructional teams. Those listed in the Participate & Learn section are those who participated in the implementation of the curriculum created and implemented by the curriculum team. Env. is environmental.

Figure 4.1 provides a sequential overview that defines the scope of this study. While most aspects of the study are encased within a chronology between 2017 and 2021, identifying the

"beginning" of the Citizen Scientist Curriculum Team proved more complicated than expected as I reflected on how and where to start the story. A combination of structural, contextual, and environmental elements triggered events ultimately sparking the creation and growth of the team over time. These mixed with the individual threads of experience that brought members to the community. The origin story of the Citizen Scientist Team and its members offered important insight into the dynamic and priorities of the community and tied to the professional questions and reflections that members came wishing to explore. Similarly, while the "ending" of this case's narrative is primarily rooted in experiences that happened within the 2017-2021 timeframe, the life of the Citizen Scientist Curriculum Team continued beyond that point offering another difficult dilemma in thinking about a "stopping" point for the story while also emphasizing the importance for it to continue to be a sustained and active community.

As the Citizen Scientist Curriculum Team evolved, cyclical processes of imagining, designing, reimagining, refining, and reflecting began to emerge. These processes took on a rhythm that followed opportunities for teachers to learn through creating curriculum in the fall and spring and then implement those ideas in a context where high school students would learn by participating in new curriculum spaces. The longitudinal aspect of this case was also significant as members of the Citizen Scientist Curriculum Team built progressively complex learned experiences that contributed to the on-going growth and learning of each member of the team. The sections of this chapter illustrate this process of growth in community-based teacher learning over time.

Prologue: Before Citizen Scientist, There Was…

The inception of Citizen Scientist is rooted in a series of three initiatives that emerged unpredictably, and as one informed the other, they eventually acted as the groundwork for the

program. Too often, opportunities for teacher learning that do align with strong principles of learning theory and that do foster deep and rich experiences are introduced in schools as *special initiatives* and, rather than being designed as sustained aspects of professional life, happen once and then end leaving little space for deep reflection or the development of expertise within the context. Considered alone, these three antecedents, a school club (the NYC Detectives), a pre-service summer workshop (Earth Science Summer School), and an afterschool workshop series (Science Fridays) could be seen in this light. However, as each served as a context for experimenting with pedagogical principles, extending understandings of learning, and enhancing school and university relationships they served as the germinating seeds of what became Citizen Scientist. In this section, I briefly recount each initiative and describe preliminary lessons that emerged from them.

The site of each of the three initiatives was a middle/high school, Riverview Academy where Katherine, a veteran teacher, began teaching in 2014. Katherine and I had previously developed a friendship while she filled the role of clinical instructor for the residency program. In 2014 Katherine shifted from the residency program back into the role of an English as a new language teacher at Riverview while I continued my own journey developing as a teacher educator at the university level. Katherine remembers, "I was interested in continuing to work with [the residency program] and supporting the [pre-service teachers] and their growth and understanding."

Katherine and I have always shared an interest in intensive inquiry-based and experiential learning and are passionate about enhancing our understanding of the role these approaches play in K-12 classrooms and teacher education. As she started in her new position, we spent time imagining and experimenting with creating non-traditional learning spaces. By nature, the central

role of a teacher is to create conditions, opportunities, and accessibility for deep and meaningful learning that is carefully attuned to the particularities of participating learners. However, just because a teacher knows that they should be engaged in a particular aim doesn't mean they have the understanding, tools, and resources necessary to orchestrate the elements needed for it to happen. The ability to create such spaces is complex and nuanced. It takes time and practice that is inevitably messy and imperfect and, even for experienced teachers, requires on-going and continued development. Katherine and I were asking questions about our own professional growth and were eager to explore these ideas.

The NYC Detectives: Re-thinking Student Leadership

One of our first initiatives was an after-school program that we imagined as an "explorers club" and was eventually named—by the first student members—the NYC Detectives. Our pedagogical aim of the NYC Detectives was to "expose middle school students (and teachers) to hands-on experiences in NYC that are authentic and that connect to content areas." In time, the students also articulated their own purpose for the program, "*The NYC Detectives are a student led club that collaborates to make field trips around New York City to gain new experiences and learn more in depth about a particular topic throughout the trips that are planned*." This student articulation mirrors the purpose developed by Katherine and me (e.g., "hands on experiences" vs. "gain new experiences," "connect to content areas" vs. "learn more in depth") but also offers a elements that highlight student voice such as the purpose being defined as "student led" and collaborative.

As a middle school student, Victor was one of the inaugural members of the NYC Detectives. He joined because it, "was a…a student-led club, and…we'd never really had that in the school." Members of the club met after school to plan and organize fieldtrips that eventually

came to be scheduled once or twice each month on Saturdays. In keeping with their stated purpose, students took the lead in making all necessary preparations—both creative and bureaucratic—as they learned to navigate multiple processes relevant for exploring the city.

The rhythms and routines of meetings were largely structured by the students and evolved as they refined their ideas of what they wanted the experience of the club to be. Victor adds:

> [I]n the beginning there were a lot of ideas being thrown around…I'm pretty sure there was no point where anybody said, "No, that's a bad idea. We shouldn't go there."…but nobody was actually sitting down and deciding, "We should do this."…[E]ventually we…realized, "We've been talking about all these great ideas, but there's no plan.

Victor's reflection is an illustration of how the group made their way through multiple gear shifts as they moved between brainstorming and planning processes. They were building collaborative structures as they appreciated and accepted each other's ideas during brainstorming. The group was also coming to realize it wasn't only idea generation and the *possibility* of exploring the city (complete with the availability of Katherine and me to join) that would lead to actual excursions; planning elements must be added as well. They were learning to shift back and forth from brainstorming to planning in their collaborative work.

A component of this collaborative planning process was cultivating a mindset that accounted for the needs of all club members and planning within those boundaries. This often emerged in the new and unfamiliar logistical elements of trip planning. Victor describes planning for their first trip:

> A lot of us never really took the train by ourselves…so planning the route to get there—and then we all were talking about, "Oh, we should go here to eat, it's so nice, five star review," and we realized, "we're middle school students who don't have a source of income. So how will we afford said food?" So, it was a lot of understanding where everybody placed social economically, as well as what is the most effective way to get to the museum, which everybody can enjoy?

Engaging in the work of the NYC Detectives included tangible outcomes—students were planning a specific experience that they wanted to have—which added to the relevance as they

continued in the process. The loosely structured elements of the work offered opportunities for club members to experiment with planning and implementation of ideas that grew from their own brainstorms. They were pushing themselves to engage in new experiences that felt unfamiliar while also accounting for elements of accessibility for each member of the group.

The work also required that club members ask questions, make discoveries, and engage with processes that were sometimes unfamiliar and required experimentation. This meant that their process sometimes included tangents and dead ends resulting in important lessons that eventually accelerated their planning process. For example, while planning for their first fieldtrip to the Museum of Museum of Cartoon and Comic Book Art took nearly four months of preparation, by the end of the following year, planning for a trip of a similar scale would take no more than one or two hours. Because of the cyclical nature of this work, when club members hit a point of implementing their ideas, they did so with the knowledge that this was one *of many* field trips which meant that the process didn't need to be perfect. Instead, there was a reason to learn from the process because there would be an opportunity to work through many more planning and implementation cycles. Students rarely find themselves in a school setting where they can spend four months testing out and cycling through the development of an idea. Schools work on much tighter timelines and because of that, these cycles of experimentation can be hijacked in the name of moving to the next topic. But does this sense of urgency lead to actual benefits of learning or is it possible that we are halting *processes* of learning in the name of unimportant priorities? This is a question that I was grappling with as I watched the club members identify, interrogate, and work through processes they were using to further explore their city.

Most of the work that Katherine and I did in the first year with the NYC Detectives centered the priorities, needs, interests, and ideas of community members of Riverview Academy. As a guest who regularly visited, often for the purpose of supporting student and teacher aims, I was situated in a way where I got to know school leadership, teachers, staff, and students who were part of the school community. I developed a strong sense of the school's priorities and when I was doing work in other contexts—such as at the college—started to identify potential connections for collaboration. I experienced the space as one where I could deeply engage in learning about how my own role impacted and intersected with the work happening in local secondary schools. This role of working alongside teachers to build experiences tailored to directly benefit students from specific school communities is often absent from the work of teacher educators (Miller & Hafner, 2008). However, when present, it is a practice that can significantly impact the learning of pre-service teachers. It is one that requires a shift of thinking that moves from *within* to *across* contexts as relationships in schools and communities become the central element in developing opportunities for learning. This framing offers important opportunities for fostering and enhancing the design of pre-service teacher learning in ways that enhance the experiences of pre-service teachers (Zeichner, 2010; Beck, 2016). It also situates the university context as a resource that could be leveraged for K-12 student learning leaning into a structure where the mutual benefit of schools and university collaboration is more evenly balanced. While this work with the NYC Detectives was not attending to pre-service teacher learning (*yet*) it established a foundation of collaboration and reciprocity that was an important antecedent to the work to come.

Expanding the focus of the NYC Detectives. By the summer, members of the NYC Detectives had developed a curiosity for the work I was doing with the residency program at the

college. Driven by their questions, Katherine and I shifted the location of our weekly planning sessions to the university context. Because club members were on campus, they had occasion to cross paths with pre-service teachers in the residency program ultimately leading to an invitation to co-plan and co-teach two university class sessions designed to teach an element of outside-the-classroom learning to pre-service teachers. Victor remembers this experience "giv[ing] a new layer of understanding" to what it means to incorporate "student interests or the student perspective" into planning. He continues, "being able to tell teachers that students do have ideas of where they want to go and make learning more interesting for them [and] the teacher was very impactful." This notion of shared decision making between teachers and students was beginning to drive Victor's understanding of what it meant to be a learner. He was learning that he could have an idea or ask a question and there was a context where those would be followed with action. He continues:

> That experience made me reflect a lot on the club itself…. Going through that process [of planning trips and visiting different places in the city] and understanding the logistics of what goes into planning certain things. It made us…bring into perspective to teachers that not everything will go as planned or is as clear cut.

This shift of context also impacted Victor's own understanding of the lessons he had been learning in engaging in the NYC Detectives and placed teachers in a situation where they could engage *as learners* with the people who would soon be learning from them. Teachers spend their days entering student learning spaces—spaces where the central aims, objectives, and outcomes are to support student learning. It is rare for students to have access to teacher learning spaces—spaces where the central aims, objectives, and outcomes are to support teachers as they develop in the profession.

As a new teacher educator, this configuration helped me think more ambitiously about contexts of learning—to account for the role that space plays in learning and the role the teacher

plays in that space. This meant learning how to be more intentional in stepping back to leave more room for student decision making and leadership. It helped me ask better questions about whose perspective is being included in the development of school and university partnerships and included factoring in new ideas about who I considered as teacher and learner.

For Katherine, these experiences were integral as she re-imagined the possibilities of student-centered learning, "it really helped me imagine what school could look like for kids based on student ideas and student interests…it started me thinking, if the NYC Detectives can do this, then my students can too." Before this, Katherine focused on developing student-centered curriculum by getting to know students and using what she learned to inform curricular decisions. Her approach grew to be more nuanced as she "started thinking about really having the kids brainstorm their interests and then develop areas of focus for the curriculum." She was experimenting with ways to share curricular decision making *with* students as she "reimagined [her] approach to curriculum and teaching."

Both Katherine and I were discovering emerging principles of practice in the NYC Detectives context and were becoming able to use those insights to inform the work we were doing in our classrooms—for Katherine, with middle/high school students, and for me, with undergraduate and graduate students. We were coming to recognize the value of collaborating with students in a low-stakes contexts to experiment with ideas of teaching and learning in ways that were meant to enhance the experience for everyone. This laid the groundwork for considering other avenues of collaboration.

As a result of our explorations, the partnership between the residency program and Riverview Academy continued to grow. Katherine agreed to host pre-service teachers during a week-long summer workshop that included an embedded field component integrating high

school science learning with English language instruction. We called this Earth Science Summer School.

Earth Science Summer School: Building Layers of Learning

Earth Science Summer School was a week-long workshop that was intentionally aligned with Katherine's regularly planned summer school class for new English learners. This workshop was one of our first attempts at creating more extended and intentionally developed learning spaces that actively involved both students and pre-service teachers. Occurring the summer prior to their residency, this was a preparatory experience for pre-service teachers that focused on "learning how to support individual students." High school students would be "conduct[ing] an investigation matching the identity of a mineral to its physical properties" and would also "develop academic language proficiency [while] engaging in project-based learning."

During the workshop Katherine took on two roles—as teacher of record for a middle/high school summer school course and teacher educator for pre-service teachers who were participating as an element of their summer coursework. Here, we experimented with a model inspired by the consulting work of the NYC Detective, especially as we considered the ratio of middle/high school students to pre-service teachers—one student to one pre-service teacher, filling the room to almost 40 people. With this type of targeted attention, Katherine's design of the curriculum was an attempt to create an experience for students that mirrored "something that a scientist would do." She explains:

> I would have never been able to do that as richly without the support of all the [pre-service teachers]. There was this beneficial relationship where the [pre-service teachers] were learning something, and they were working with students, and that was part of their coursework, and I was benefitting because I was able to make sure my kids got all this one-to-one, hands-on kind of experience that you would do as a scientist when you're working in a team.

This bifocal approach highlights the importance of reciprocity that Katherine and I were both experiencing as we collaborated to develop an instructional learning experience intentionally designed for both pre-service and student learning. This approach accounted for resources that were expanded through the inclusion of pre-service teachers in the class resulting in significant modification to instruction—pairing one pre-service teacher with one student, de-centralizing instruction in the classroom, and prioritizing a hands-on approach *for all.* This approach aided pre-service teachers in developing a sense of the pedagogical possibilities that might exist outside of the realm of their own experience while also coming to associate those practices not with just a theoretical idea, but instead with concrete practices that were being implemented in the classroom.

Imani was one of the pre-service teachers working with students in Katherine's class. She remembers being struck by, "how science is super accessible for [English learners]… it's just the way that it's taught that typically it's not." In thinking about her own development as a teacher, she adds, "that [experience] is what started getting me thinking about science for ELLs and science literacy specifically [and] teaching literacy through science…to ELLs and students with low literacy." For Imani and others in her cohort, this experience enabled her to contribute to and mirror Katherine's pedagogical practice in real time while witnessing the outcomes of those approaches. The cohort was observing learning processes that may not have been "typical" in their own schooling which aided in recontextualizing preconceived notions of what students (and teachers) can and cannot do. In work with individual students, they were actively practicing the approaches modeled by Katherine and in their after-session debriefs were reflecting on the outcome of those experiences as a group.

At the end of the week, the students and pre-service teachers visited a museum exhibit of

minerals and gems. Here we modeled the possibilities of learning that comes from a change of context. This change was an opportunity for students to apply what they learned over the course of the week and for pre-service teachers to watch student learning as they further developed relationships with their focal students. Imani recalls:

> Seeing the students interact in the museum…having some sort of culminating event where kids are actually [experiencing what they are learning] is a cool way to…kind of like how their authenticity—the authenticity of experience—increases once students have gained certain levels of access to content….that experience became much more authentic [with the scaffolds and supports that were part of the instruction] and they were actually able to navigate through the museum in a way that was more meaningful than just, "I'm at the museum."

By putting pre-service teachers in contexts where they were seeing examples of student curiosity and excitement, we were attempting to establish a foundation of pedagogical possibility. As they developed their own sense of what teaching and learning can be, the setting offered the experience of working together side-by-side as pre-service teachers were placed inside a learning situation where there was a reciprocal benefit. This extended their sense of potential for who can learn and benefit in a given context. Situating the learning experience in a way that allowed pre-service teachers to recognize "authenticity of experience" pushed their conceptualization of theoretical principles through the instructional experiences where they were active participants.

Science Fridays: Seeds of Pre-Service Teacher Empowerment

Through the 2016-17 academic school year Michael, a pre-service teacher, worked with mentor teacher, Lauren, in a science classroom residency at Riverview. Already knowing Katherine from the summer, Michael volunteered to also work with her after school to offer hands-on science learning experiences as part of an on-going program named Science Fridays (a nerdy nod to the long-standing National Public Radio series).

Michael knew "Katherine was looking for some ideas for the science aspect" as she worked to support students in developing a science-specific language base. "So, I was like, "oh, I have plenty of ideas…[and] I went over on Fridays, and I knew kids like food, so I came up with any science activity that incorporated food." Science Fridays became a space for Michael to experiment with potential teaching strategies that incorporated aspects of hands-on science learning. He adds, "I didn't know what I was doing…[and] I wasn't always aware of the language development that I was doing, even though I actually was doing it with Katherine." Here, Katherine offered Michael instructional supports for applying theoretical principles of teaching and learning as he tested new instructional ideas he wanted to try. Informed by his own experiences, his work in the residency with Lauren, and the time he spent with Katherine in the summer, Michael had a general sense of what he wanted his approach to look like but needed a low-stakes space where he could experiment with his ideas while having the support of others to help him interpret "what [he] was doing." Katherine recognized the benefit of instructional experimentation for Michael and the students. This became an opportunity to learn together as Katherine created a context where Michael could try his ideas with the students. As a person who was regularly experimenting with her own practice, now Katherine was developing a structure that included Michael as a co-experimenter. Michael remembers:

> There's nothing better than having the students do hands-on things…to be able to describe things and that would help with the language development. And then obviously there's all these other scaffolds that go in place there…I remember that impacting me.

These small sessions of pedagogical exploration acted as an opportunity for students to build community in the context of their own academic exploration. They were a way for Katherine to create experiences for students to be introduced to, practice, and apply academic language. They offered Michael a space to try ideas and pedagogical approaches that would inform his future classroom teaching. While each person might have been participating in

Science Fridays with slightly different aims, all were practicing a process that reinforced the benefit of innovative instruction while encouraging on-going trust, and a commitment to curiosity.

In the spring before graduation, as Michael looked forward to a new teaching position and he reflected on his preparation, he thought about strengths and weaknesses of the residency program. He considered each of the four instructional pillars that ground the program and extent that they were embedded into the experience. As a science teacher, Michael contemplated on the role of one pillar—STEM Literacy and Enrichment which informs growth of knowledge and skills to support students in developing STEM literacy. At the end of the program, Michael was left wondering about the balance of attention that was paid to this pillar. He explains:

> I realized that I didn't get…enough STEM…out of [the program]. So I approached you [Suzanne] and said, "Hey, this is a great program but that one pillar around STEM, I think that pillar needs a little strengthening," and you agreed….then you approached me and said, "well what kind of ideas do you have?"

Michael's critiques and questions highlighted a programmatic problem our residency program team was already grappling with. Michael's content coursework had been science-focused and certainly introduced him to important concepts and ideas connected to science learning and teaching. However, the aim of the STEM Literacy and Enrichment pillar was different from the content coursework as it focused on preparing teachers across certification areas to develop strong structures and strategies for supporting students, especially English learners and students with learning differences, to make STEM content comprehensible, exciting, and relevant for all.

Michael was recognizing a feeling of incompleteness in his learning that is not uncommon for pre-service teachers who are about to take on the task of fully entering the profession. He had spent a year with a teacher safety net as he worked alongside experienced teachers who shared his passion for supporting student learning. Now, as he prepared to begin

teaching in a new context, he wondered what it might look like to enact these ideas alone. He also saw his pre-service learning community as a resource and a context where he could still ask new questions and offer feedback about potential gaps for him and others within the community. Now at the end of his degree, as he asked himself, "what now?" in consideration of his own learning, he saw the residency program an on-going context for his professional learning.

I was interested in Michael's perspective as a program graduate and former field scientist and wondered how this question might inform next steps for the program. This wondering was in keeping with other conversations that were becoming increasingly common with program graduates. At the time, alumni were becoming more actively involved in opportunities to develop curriculum, design learning projects, and participate in other affiliated opportunities. They acted as supports for pre-service teachers who were working to complete certification requirements, assisted in facilitating course sessions in core courses, and invited residents to visit their schools and classrooms. As graduates continued to engage with the residency program years after completion, many were invited to act as mentor teachers after having taught for four or five years. Structurally, the residency program was already evolving in ways that encouraged graduates to stay connected and to offer ideas for programming that would impact related pre-service and in-service teacher experiences. These practices laid the groundwork for the development of an active community of educators who had varying levels of experience and identified the residency program as a space for enacting their ideas. At this point, the institutional trust that came from this common experience offered a shared foundation for entering and re-entering the space. While not always successful in taking an idea and moving it to fruition, a growing number of initiatives, passion projects, and experiments seemed to be emerging (both

predictably and unpredictably) from this increasingly complex system. This generative context was vital in laying the groundwork for what was to come.

4.1 Learning Through Inquiry: Pushing Past the Point of Comfort

> When we were out in the field, [Michael] was still thinking like a field scientist and a lot of our conversation…when we were making the curriculum was me being like, "Hey, we got to remember a couple of things: how [will] we break it down? [and] how are we going to make this approachable? For everybody. We're going to have to model all of this, we're gonna have to repeat instructions, we're going to have to break it down. There's these big complex ideas. The health of an ecosystem is extremely complex. And Michael has a much greater understanding of it than I do. And he had more recently been doing it. So he had these cool, really big ideas, which lit a fire under me. And then my job was often to like, "okay, let's remember the perspective of our students, where they're coming from. We're gonna meet them where they're at and build up to these complex ideas."
>
> — Lauren

Experiential learning centers real-world interactions as a key factor within a learning process (Williams, & Sembiante, 2022) and emphasizes mediation between concrete experience and meaning making or reflection. The back and forth between concrete experience and meaning making results in a cycle of discovery as the learner makes connections to broader ways of understanding the world (Morris, 2019). New teachers often come into teaching having learned *about* the importance of embedding elements of experiential learning into the K-12 classroom. Absent of concrete experience, talking about pedagogical practice can still offer opportunities for teachers to develop a vision of *what* might be possible. However, this ignores a teacher's need to experiment with *how* these theories might play out in the pragmatics of the day-to-day. They also typically have some type of field-based experience that is meant to inform their understanding of processes of teaching and learning. Yet, the concrete experience of fieldwork does not always foster connective threads to strong critical meaning-making essential to the learning process. Without these reflective intersections, field-based approaches fall short of creating spaces designed for experiential learning—spaces intentionally linked to questions of instruction,

conversation, and critical reflection that shape teachers' pedagogical decision-making. Just like students, teachers need opportunities to engage in experiential experimentation where they can ask questions, engage in processes of doing, and make meaning of the outcomes.

In April of 2017, initial planning for the new residency cohort's summer coursework was underway. Katherine and I felt satisfied with the Earth Science Summer School outcome of the previous year and prepared to repeat the workshop as a culminating experience for the summer. We felt the workshop was a rich way of meeting our objectives for pre-service teachers (e.g., introducing strategies for building academic language scaffolds, providing structured opportunities for careful and close thinking about supporting the learning of one student, considering the scope of learning context and extending it beyond the classroom) and high school students (e.g., introducing, practicing, and applying academic language that would be used in Earth Science the following year, providing a rich, meaningful, and hands-on experience that mirrors a type of work that scientists do), and looked forward to the workshop's reenactment. But, as Victor and his NYC Detectives colleagues taught us, "not everything will go as planned, or is as clear cut." We would soon learn that this would be one of those times.

Unexpectedly, and almost overnight, plans for Earth Science Summer School began to unravel. "I got sick and I didn't get to apply for summer school on time," Katherine remembers thinking back on the one element that started the unanticipated chain of events. Katherine's role as a Riverview summer-school teacher was integral to our plans. Like the previous year, the central purpose of the week was to create an environment where pre-service teachers and high school students could work side-by-side in ways where learning was situated in experience. Katherine was the person providing a point of access to high school students and a school-based

classroom space. We now had neither of these things so there was no getting around a need to drastically change our plans, but in what way?

If this had happened outside of the context of lessons that came from the NYC Detectives, Earth Science Summer School, and Science Friday experiences, it is likely that we would have chosen to shift away from aspects of planning that required a middle/high school student partnership. We would probably have cut our losses and considered what we had envisioned as unattainable for the year, and instead moved toward less collaborative learning options that were situated in the university context. While (probably) logistically easier, a decision to shift in this direction would have meant setting aside our focal purpose of creating a space where pre-service teachers could experientially interrogate their assumptions about learning. Ultimately, we decided to attempt other ways for creating this learning opportunity.

Through our previous experiences we had seen the benefit of, as Katherine put it, "that relationship between [pre-service teacher] learning—and learning in a hands-on, science-based program where…[the students] are really doing something that they would actually do if they were also…field scientists." We knew we needed to consider possibilities for situating pre-service teachers in contexts that pushed them to interrogate their assumptions and understandings of what rich, rigorous learning could look like for students. We also wanted pre-service teachers to be thinking about who the people are who most typically have access to encounters with experiences such as scientific fieldwork. When learning opportunities like fieldwork or other science-based programming come up in high schools, it is often students with histories of strong academic outcomes who are recruited to participate. These experiences outside the four walls of the classroom offer new opportunities to explore potential applications of academic learning that expand understanding of the world. Who gets to have these out-of-the-classroom experiences is

especially restricting in contexts where teachers and school leaders limit expectations of those not traditionally considered *strong students,* which can result in minimizing access to experiences that augment opportunities for discovering hidden interests and strengths while enhancing learning (Milner, 2020; 2012). This is grounded in deficit-based assumptions about what some students can and cannot do. Katherine offers one example:

> [P]eople… [assume that English learners] can't do these kinds of higher-level critical thinking activities because they don't have the language to do that. They end up having this fairly impoverished curriculum...that's so focused just on the testing because they think that, "Oh well, they have to pass these tests so let's just focus on what exactly is going to be on the tests." And give them nothing more…I think that's still, unfortunately…an idea that a lot of people have about English language learners. So that takes some unlearning because it's an unconscious assumption that people might have. They just don't even realize that it's an idea they have...They just assume...kids that are English language learners...[are] not going to be able to do activities like that, and so the [pre-service teachers] have got to see [what is possible].

In this case, we aimed to directly address some of these problematic and invisible perspectives. To do this, we envisioned designing an experience that targeted participation of English learners that would also place pre-service teachers in a context where we challenged common misconceptions that often result in students experiencing "fairly impoverished curriculum." Instead, pre-service teachers would see and be part of rich and rigorous learning with students. Katherine and I were refining our own understanding of the learning and *unlearning* that were essential for pre-service teachers to know how to create these kinds of opportunities for students in the first place. "We were thinking about teaching them how to support English learners…with the scaffolds that they need in order to meaningfully participate because there's all those components of it," Katherine remembers. Building that conception of possibility has to move beyond conversation and must be grounded in lived experience because it so often runs counter to what pre-service teachers have personally encountered in schools. In theory creating learning opportunities where students are doing "these kinds of higher-level

critical thinking activities" is something that the vast majority of teachers support. However, without the experience of actually implementing those ideas in-real-time they are much more difficult to create. And too often, students' failure to get to that imagined outcome is not connected to pedagogy or resources, but instead to conclusions of what students can and cannot do.

For us, shifting that pattern meant we needed to involve middle/high school students and we needed to pull pre-service teachers out of the university context. Because of this, we opted for a less predictable path for planning and began to rethink possibilities of the workshop in ways that felt a little like pushing toward the edge of chaos as we considered what we might do. With this idea in mind and despite the missing summer school infrastructure that had previously acted as a structural framework, Katherine remembers, "we said, 'oh… well, let's think of something that we can do in lieu of [Earth Science Summer School]."

It was at this point that we reached out to Michael and Lauren, to see if they were interested in helping. Lauren, a teacher at Riverview had been collaborating with the residency program for a few years. She had hosted students in her classroom as they worked to complete fieldwork assignments where they often observed her experimenting with inquiry-based, flipped classroom, and experiential teaching methods. In 2016, she had agreed to mentor Michael and the pair had just completed a year-long residency together. This also seemed like a good opportunity to challenge Michael as he continued to develop his teaching practice. I had taken his critique regarding our lacking opportunities to learn about and experiment with STEM literacy and enrichment seriously and was interested in what ideas he had for enhancing this aspect for the new residency cohort's (and his own) experience. As we considered possibilities for the summer, Michael drew from his personal vision "of students going outdoors, doing some

of the same things I did as a kid to get me interested in science" while Lauren pulled from pedagogical principles of inquiry-based learning that were key tenets in her classroom. Lauren remembers:

> Michael used to do ecology for fish farming, and I used to do entomology, and specifically aquatic insects. So…when we were trying to put this together, we wanted it to be as field based as possible so kids would feel like actual scientists. I was like, "Okay, this is perfect, you're into aquatics, I'm into bugs…. Let's do insects and we can talk about environmental health too because these are all indicator species for the health of a river." And…it also required data collection and data analysis, which we knew was going to be important. I remember that being the big, like, "oh, this will go to our strengths and will be really fun."

By aligning this instructional experiment with a pre-service teacher workshop, we created a circumstance where we *all* (veteran teachers, new teacher, teacher educator) were exploring the unknown together, leaning into our strengths, and relying on the varied backgrounds of each member of the group. This was true from the perspective of high school student-facing curriculum as Lauren and Michael drew from their own scientific areas of expertise to think about possible options for students to do things that mirrored the work that scientists do. This included elements that felt familiar for both of them (e.g., incorporating elements of data collection that aligned with their personal experience with scientific fieldwork) and also included elements that would be different and new (e.g., supporting *students* in enacting those same processes of data collection). Similarly, Katherine offered an added layer with her knowledge of English language development as scaffolds and supports for accessibility were embedded in the curriculum. Both Katherine and I came to this work considering yet another layer as we accounted for the pre-service teacher learning that was integral to our purpose in initiating the project and worked to add structures and access points for pre-service teachers to interrogate their assumptions about when, where, how, and for whom learning happens.

To reinforce modeling of a co-teaching instructional structure, we asked another Riverview teacher, Alex, to join the team. In his role as a special education teacher, Alex regularly teamed with Lauren as a co-teacher. Additionally, Alex had experience working as a residency mentor teacher so he was familiar with the general vision of teacher learning we were attempting. Adding Alex's contributions to the team expanded our shared perspective and expertise as we built the experience for pre-service teachers and students. In thinking about her experience co-teaching with Alex, Lauren said:

> [Alex's] amazing.... [We] had a really established co-teaching relationship…because he and I were already so established, and he had a different skill set than mine as a special education teacher, we already had a lot of systems in place…. And when I was explaining something poorly, or…providing material in an inaccessible way, he knew how to read me and correct it.

Most of the pre-service teachers graduating from the residency program go on to accept positions in co-taught classrooms. Because of this, the aim of the program is to offer as many opportunities to see and experience examples of co-teaching model the work of "a really strong team" as much as possible. While most pre-service teachers in the program also complete residencies in co-taught classrooms, this summer experience offered a vision for approaches to teaching that could effectively support student learning and that extend outside the classroom context.

And so "that's where we got our core group," Katherine remembers. At the time, as this earliest iteration of our team prepared for the July workshop, we did not realize how this project—unexpectedly formed out of unfortunate necessity—would grow. At the time, this was all very new for everyone. There was no framework or set of requirements beyond those that we created for ourselves. We were not thinking about what would happen next and had very little sense of what would result from the implementation of our plan. We were leaning into the experience and seeing what would come of it.

As a university-based teacher educator, my own role in initiating this initial exploratory experience had been almost accidental. I had extended (desperate) invitations to participate in a last-minute, by-the-seat-of-your-pants pre-service teacher workshop. My preliminary invitation of, "hey, will you come and do this thing with me? And by the way, it starts in two weeks," led to an opportunity to preliminarily test out ideas that had been on the minds of members of the community. In seeking to design an opportunity for pre-service teachers, this had become a context for teacher learning that extended to others in the community (including myself). My own thinking about pre-service teacher instruction shifted beyond a context of one teacher educator to one class of pre-service teachers ratio and the result more closely aligned with the community-oriented principles of learning I regularly taught to them.

As we prepared for the workshop, we planned for pre-service teachers to spend one portion of the day interacting with and observing the participating high school students and a second portion participating in pre-service teacher-facing workshops where they would make meaning of what they were seeing and reflect on principles of learning. The pre-service teacher facing workshops would be co-facilitated by an instructional team that included Katherine and a resident graduate from previous cohort. Lauren, Alex, and Michael would focus on high school student instruction with Lauren also sometimes stepping into the pre-service teacher workshops to offer specific insight into what the pre-service teachers were seeing. I would support both groups by facilitating logistics of space and materials with the help of a final member of our instructional team, Ivan, a high school student and one of the founders of the NYC Detectives, who was interning with the residency program for the summer.

In securing a location for the workshop, Lauren and Michael used contacts with a local conservation alliance. The organization "serves as a coordinated voice for the river…to protect,

improve, and restore [it]" (Bronx River Alliance, n.d.). Educators from the alliance helped us access a meeting point at the river, offered advice as we made plans, and volunteered time for a last-minute data collection training session for the high school students as part of the experience. Shifting the curriculum pushed our sense of possibility and solved our lack of school or university classroom as we set both aside, opting instead for the riverbank as our learning space. In schools, what teachers would like to do with their students is often tethered to their assumptions of what is possible. These possibilities are mediated by external situations, constraints, and barriers that more often lead to conclusions of, "it can't be done" than, "how can we do this?" As we planned for the summer, we were challenging ourselves to push against these assumptions. Our own situation of missing the summer school sign up deadline presented a catalytic constraint that prompted a complete divergence from our original vision of Earth Science Summer School. We were depending on our capacity to pivot past that point of perceived possibility and instead identified new strategies for approximating our aim. In this case, that process quickly moved us toward a realm far beyond our original plan.

Implementation: Lessons in Teacher Exploration

Most of the planning for this 2017 workshop was finalized after school had been dismissed for the summer. This meant our strategy for recruiting high school participants would have to extend beyond school-based announcements and advertisements. Because of the work we had been doing with the NYC Detectives, both students and parents had some familiarity of what we were proposing (e.g., visiting unfamiliar parts of the city, experiencing a new form of learning) as Katherine reached out to pitch the idea. Katherine leaned into those previous experiences as she "wrangled up the kids…that were willing to participate."

The workshop happened in the last week of July. Michael describes, “we brought the kids to the [river], had them jump in the water with waders, which they had never experienced before, and then started collecting macroinvertebrates…. We had fun having the kids play around with science doing fieldwork.” Those descriptions of “jumping in the water” and “wrangl[ing] up the kids” highlight the open-ended nature of the experience designed by the team. The aim was not to have a perfectly formed instructional space with neatly prepared materials and predictable outcomes. Rather, it was meant as an opportunity for exploration and experimentation. For our newly forming team, we were exploring the boundaries of our own assumptions in defining possibilities for creating a learning space as we considered who the learners were who would have access to it. Each of us was pushing beyond the realm of our experience as we attempted a pivot toward experimenting with the idea of creating learning situated in the local community. We all theoretically understood the benefits of this kind of learning but had little sense of what it really meant to facilitate the space where it was happening. In parallel, pre-service teachers were engaging as they experientially interrogated their own assumptions about teaching and learning while watching and participating in a professional act of boundary pushing. Meanwhile, high school students were introduced for the first time to the experience of “doing fieldwork” that mirrored the work of a scientist as they “play[ed] around with science.”

Building Academic Momentum: Using Experiential Learning to Encourage Student Buy-In. During the week, high school students collected macroinvertebrates—aquatic bugs that are an indicator of health of a river—as one of two forms of data collection. Macroinvertebrates were identified, counted, and eventually returned to their river home. Awkwardly clad in chest-high waders, students walked to the middle of the river with a net attached to a broom-handle pole. To collect their data, one or two students would take small steps in an area in front of the

net to stir up sediment on the river floor while one student held the net to collect whatever might be caught up in the river's flow. Lauren remembers "I just have a very clear image of watching three of the girls all holding hands, trying to keep one up and then all three going in." We both laugh at this memory of the three girls falling into the knee-high river water and standing up with a look of shock on each of their faces. Lauren adds:

> And I'm out there like, "you're safe, you're safe, just stand up, you're safe." And they were like, "bup, bup, bup," and they're all giggling and they're having a great time. It didn't matter. They all got up and just took off their shoes and kept [going].

Lauren laughs again and then continues, "I was really proud of them for that. I was like—I don't know—there's some real motivation there." In this context, students were working through processes that mirrored those being used by our partnering conservation alliance to monitor the health of the river. Students were doing real scientific work as they asked questions, connected their fieldwork to a bigger picture understanding of the health of the local ecosystem, and practiced processes for engaging with high level texts—scaffolded with their English language proficiency in mind—that were relevant to the experience. Watching students in this context affected Lauren's own understanding of student capacity as she watched them move through challenges connected to their learning. She explains:

> It seems so silly but watching kids…not be deterred by the challenge, the newness, or the discomfort of it. It's something that…really invigorated a lot of my teacher self after this. And even watching kids fall in, get completely saturated in their clothes, completely fill up their boots, and then just empty them out and go right back in. And how that seems like a huge inconvenience and a huge discomfort. And because they were so engaged and had so much buy-in to the project, it didn't slow them down.

It can be tempting to think about an ideal learning space as one that is working *toward* comfort. In an effort to meet students' needs, we can find ourselves over-correcting, providing access to more supports, more technology, more bells and whistles. In this case, it wasn't comfort that was acting as an anchor for engagement. Students were going home soggy, hot, and tired—

and they were excited to come back the next day to learn more. In reflecting on this situation, Lauren juxtaposed this with her own classroom as she considered principles of student engagement that might inform her classroom teaching practice.

> [I]n a classroom a broken pencil tip can be enough to put a kid over the edge, or sweaty clothes after gym class, or a lunch they don't like being served, like these little minor inconveniences in a classroom that—where the things just aren't as exciting, or the buy-in isn't as great, or it doesn't feel as important to them—is enough to derail everything. But watching these kids work through wet clothes—and it didn't matter—all day. It really shows how powerful engagement is in student learning.

Even for a veteran teacher like Lauren, these moments offered an opportunity for reflection and learning as she watched students navigate challenging moments in this new, less familiar context. Students' "buy-in" led to a buildup of academic momentum that was strong enough to propel learning even through difficult moments. Instead of being "derailed" by the situation, wet socks added to the overall experience of learning.

The Art of Rock Sitting: Finding the Balance Between Sitting and Swooping. In our Citizen Scientist archive, there is a picture of Lauren and Alex sitting on a couple of rocks next to the Bronx River. In front of them is a cluster of five students—all wearing goggles, gloves, and army green waders rising up to the middle of their chests. Prior to the moment when this picture was taken, Lauren, Alex, and Michael had given the students water quality test kits—the second data collection method of the workshop—and a mission to complete the tests described in the English/Spanish instruction manual. These tests would give students information about levels of elements present in the water. When I look at this picture, I see so much movement in the students' bodies. One kneeling student holds a test tube while a second reaches down to pick something up from the kit. A third student is frozen, midstride, as she walks toward her supplies, ready to add river water to a test tube that she holds. Over to the side, another student kneels on the ground and is reading from the instruction manual. By his side, a final student watches him,

intently holding a laminated color chart that is used to decipher the results of a test that they are completing. I see intense focus in all their faces. The students don't even seem to be aware that this picture is being taken, they are too busy with the task at hand. Each is clearly immersed in what they are doing.

At the same time, when I look at Lauren and Alex, I see stillness. Lauren sits on a rock. Both hands encompass a cup of coffee that is settled in her lap as she looks over to the working students. Alex looks toward the camera with a slight smile on his face. He sits on another rock leaning forward slightly with an arm on one raised knee. Both have stepped back to give space for the students to explore, struggle, and discover with focus and curiosity. In reflecting on that moment, Lauren states:

> …[C]hildren and adolescents are always underestimated. And your trust in an adolescent is the biggest gift you could give them…. Being able to deflect a lot of the responsibility for making sure things get done onto the students is a huge way to show that you trust them. And they get a lot of buy-in that way.

This sense of trust, exhibited through stillness, is something that we've worked to continue to develop, model, and refine in subsequent years. We have worked to embrace those moments of pedagogical quiet where teachers are *sitting on the rocks* and trusting students to take ownership over what they are exploring. We have come to recognize the importance of slowing things down to make space for learning and helping pre-service teachers to see and understand what is happening in teacher stillness. Part of this is helping pre-service teachers to experiment with practices in, as Lauren describes, "…giving space for trying something, giving space for mistakes…[rather than] swooping right in, trying to problem solve right away." Pushing away from *swooping* to solve students' problems and instead leaning into the practice of rock sitting requires teachers to interrogate their beliefs of what students are capable of doing. It challenges them to reconfigure ways they exhibit trust in students' abilities to be agents in their learning

process. Taking a step back signals that confidence, that sense of "you've got this" that sometimes requires a teacher to show a level of restraint that can might feel counterintuitive.

These experiences informed Lauren's own practice as she developed additional insight into her instructional approach and her own endeavor to balance "swooping" and "rock sitting" in her classroom. She describes:

> After that I backed off even more, I swooped even less….I had already set up classrooms where the students had full ownership over their learning, and had access to learning 24/7….And I was even more of a facilitator. There was a lot of sitting on the rocks…. [T]here's a lot of planning that goes into making a classroom run like that—but watching those kids problem solve and being able to just throw these things at them—be like, "okay, figure it out, yeah, here's a giant net, go in that water, you're safe, you're good, you're good."

"Watching those kids" was an integral part in Lauren's own experimentation with learning and teaching. By leading this workshop that was geared toward pre-service teachers, she had space to interrogate her own practice as students worked through water quality testing, embraced the challenge of macroinvertebrate data collection, and got back up after (literally) falling down to continue on in their endeavors. These moments helped Lauren develop a refined image of student engagement that informed her understanding of learning across contexts—an image she wanted pre-service teachers to share as well.

At different points in the workshop, pre-service teachers joined teachers and students in moments of deep focus. This often led to "chaotic moment[s]" as "we all came together on the banks of the river." These are moments, when more experienced teachers helped pre-service teachers understand the instructional strategies being used—they were working to make rock sitting a visible pedagogical action:

> I felt like most of what I was saying to the [pre-service teachers] was like, "you can back off," like, "let them try it," or like, "look at, oh, look at the solution they've made over there." Like,…"let's sit back and observe a little bit." You don't need to coach every single moment.

There is a certain ebb and flow represented here as experienced teachers took a step *back* from high school students as they explored scientific concepts. Simultaneously, teachers stepped *forward* to intentionally guide pre-service teachers' actions—to help make visible and understand the intentionality in this pedagogical action. Because this was an experience situated within a learning context, that guidance came as pre-service teachers were seeing its result. In some ways, it was a moment of swooping toward a few pre-service teachers who were attempting to coach the students to identify specific organisms, as teachers pushed pre-service teachers to experience a rhythm of learning oriented toward rock sitting—making space for experimentation and setting aside feelings of urgency to coach or quiz. Lauren continues:

> [P]art of the benefit of having such a range of experience…is the [pre-service teachers] could observe the more veteran teachers observing the students and how and when they interact. And how little you actually need to step in and correct in a science classroom…. You want the kids to come up with their own solutions, you want them to work as a team. It doesn't matter if they're not being efficient. It doesn't matter if that's not…exactly [the] right way to use the tool, or if somebody fell in the water. It's okay, it's fine. It's okay to step back and watch the learning happen and facilitate the learning instead of swooping.

There is an element of emotion and feeling that is inherently embedded in experiential learning. The feeling of frustration when you try something and it doesn't turn out quite right. The feeling of exultation after making it through an extreme challenge. Experiencing that emotional component can help calibrate learning as you figure out how an action feels and the response you have that is associated with it. This was a situation where pre-service teachers could see moments where more experienced teachers stepped back and sat on the rocks in order to facilitate learning of students. It was an opportunity to begin to recognize those actions as intentional pedagogical decisions—decisions that are connected to actions of teaching that lean into moments when teachers are observing and listening. These teaching actions are sometimes more difficult to discern than giving students instructions or speaking to the full class. Because of this, they may come with feelings of uncertainty as teachers may ask, *what if someone saw me*

doing this right now, what would they think I was doing? The art of rock sitting often runs counter to expectations that teachers face in a classroom context where the pressures of success are regularly connected to the teacher's ability to say the right words, ask the right questions, or assign the right work. This is a culture that most have experienced as students. It is one that, rather than slowing things down, is designed to speed things up as teachers swoop in to move students along in their work. Reflecting on this tension, Alex adds:

> [W]e're always held accountable to some type of state assessment and we've got it into our warped mind that the only way that students can prepare and be successful on an exam at the end of the year is for them to sit in a classroom for 185 days a year and listen and just sit there and be vessels of whatever we're going to say and just receive it and remember all of it. That traditional instruction is how I walked into my experience as a teacher because that's what I saw. The program allowed me to see, to learn, that that's not the only way that students can learn. That there's many different ways that can happen.

In working to create this space, our aim was to address assumptions such as these while severing preconceived notions that limit understandings for how students learn that result in myopic instruction that are homed in on successfully exhibiting learning through external indicators of knowledge such as end of year standardized tests. In doing this, we hoped to illustrate the depth of learning that comes from embedding experience and context into what is happening. Further, we hoped to challenge the tensions between teachers feeling a responsibility to swoop and instead recognize that intentional rock sitting could be an element of supporting student learning. In doing this, we were addressing elements of emotion and the "significance of emotionality in particular areas" (Hargreaves, 2001, p. 1057) of pedagogy and are sometimes neglected as "more technical and cognitive science-driven conceptions" (Hargreaves, 2001, p. 1057) are prioritized. This highlights the notion that decision making and actions of teaching are not motivated by thought alone, but instead that the "sources of teacher behavior are much more complex, cognitive as well as affective and motivational and often not conscious to the actor" (Korthagen, 2010, p. 101). By balancing experiences that lean into feeling that comes with

different aspects of instruction—especially moments that push against a teacher's natural proclivities—pedagogical learning can be extended in new ways.

Community Trust: Breaking Norms and Reimagining Learning

In the end, this experience added up to a complex hodge-podge of people coming together—high school students generously dropping a week of their summer plans and agreeing to spend time alongside pre-service, new, and experienced teachers, as well as teacher educators from the residency program. This included an experience where there were "many levels of relationships" (Lauren). These fostered a space where "there was a sense of trust" (Alex) even at moments when "a lot of different learning was going on" (Lauren). This resulted in a learning experience that was an opportunity to "play around with science" (Michael) in ways that were "rich and meaningful" (Katherine) for high school students, pre-service teachers, and us. At the time, our approach, process, and understandings about how to design learning experiences for such a range of people was new for all members of the team. This meant that existing relationships where team members could "lean on [a colleague when I needed advice" (Lauren) and trust each other in ways that could extend perspectives for pedagogical decision making, especially during the most chaotic moments were vital. With a shared purpose in mind, these relationships also supported ambitious thinking about instruction—the kind of thinking and planning that, individually, we each might shy away from due to feelings of trepidation about the unpredictability and scope of such an undertaking.

When looking across that spectrum of participants, members of the group were being placed in a context that pushed them to reimagine how to apply pedagogical ideas to their teaching practice. For example, when considering the learning of the high school students, Alex observed:

> It was nice to be outside with students, it was nice to have students conduct these fields assignments and really get to see how the concepts they were learning in the confines of the classroom were applied in the real-world. It felt like they had an opportunity to really engage with that and have a better understanding of how pollution was impacting their local community…right in their backyard.

This context, specifically situated within the local community, offered immediate "real-world" application to concepts for students. It also offered an opportunity for teachers to see students "engage" in ways that resulted in them "hav[ing] a better understanding of how pollution was impacting the local community." These observations reinforced "the fire" of teachers to engage in an experience that was a steep learning curve for them. By and large, the teachers and pre-service teachers participating in this project did not have many of their own formal learning experiences that mirrored what happened during this week. This meant that pedagogical decisions were made with less information about the potential outcomes of the experience. The group was resisting the "apprenticeship of experience" (Lortie, 1975), a context where decisions are made in relation to what is known, and were instead pushing into the unknown as a context for learning was created that introduced an element of mystery and newness in learning that resulted in discovery rather than simply confirmation of the known. Alex offers one juxtaposition in reflecting on his own experience as a student:

> We've all been students. We've been in their shoes before and it's so funny that I graduated from high school almost 20 years ago (we're getting close there) and in my classroom I can look at my students and I can see that other than maybe an overhead projector and some fancy smart apps education is pretty much the same. You're learning the same things; you're learning the same way. We wanted to break that. We wanted to break what that looked like.

In this situation, we were all learning in a new way. Yes, Michael and Lauren both had scientific field experience; Katherine and I had both spent time taking students on field trips and working with them outside of brick-and-mortar classroom spaces; and Alex had walked into many learning spaces and developed on-the-spot scaffolds and entry points for students.

However, none of us had experience developing a new learning space that explored the intersections of these elements that so explicitly pushed against standard practices of schooling. It was the combination of our shared experiences that allowed us to effectively facilitate this push. It was also a decision to set aside the familiar and instead align our instructional decisions with the principles of learning that we had envisioned as a group. Alex describes this vision as:

> [W]e've always shared the idea [to] change the way instruction looks and feels and let's give opportunities for our students to build the skills that we already know that they have and give them the confidence to rediscover those skills…and just really refine them.

In the creation of this workshop, this experience was not meant to model polished or perfectly predictable curriculum design and implementation. Rather, our aim was to expose pre-service teachers to the experience of experimenting with instruction as we also introduced them to pedagogical models that would aid in the process. This was an opportunity to see teachers in the act of pushing our own boundaries as we attempted to "break" from the norms to which we were accustomed while introducing the tools we were using to do so. For all of us, this was an opportunity to interrogate our assumptions of where and how learning happens. How open-ended could our design be? How far could we push the constraints that often seemed to limit possibilities of learning? These are questions connected to our attempt at enacting this project.

This included ways that our team was learning to proactively problem solve and engage with the barriers that may seem to define strict boundaries in our assumptions about what schooling is and is not. Katherine states:

> I see so often that [pre-service teachers] go into their residency, or they go into their student teaching placement and they just get *schooled* in how school is. Like the culture of school and it really takes some of the joy of teaching out.

So much of this "schooling" comes from unspoken actions and observed ways of being that are internalized and enacted in the classroom on a day-to-day basis. By making space for teachers to play with their practice, pushing ourselves to "break" with some of the traditions of schooling,

we also had the opportunity to offer a model for teaching and learning that extended outside the scope of what previously seemed possible for everyone involved. For the pre-service teachers, this meant being placed in an unpredictable context where they could interrogate preconceived notions of where and how learning happens. Alex explains:

> A lot of learning, at least from the [pre-service teachers] was—right from the get they saw that something like this can happen. That you can do this, but it's going to obviously take a lot of assertiveness and pushing on your part…, and creativity to be able to design learning activities that resemble or reflect what we were doing with our students.

For teachers who were part of the team, this meant intentionally breaking from the day-to-day decisions that were typical for classroom instruction. We were instead challenging ourselves to imagine something different while intentionally taking on the risk of experimenting with new ideas as we worked alongside pre-service teachers. Meanwhile, we found ourselves teaching in a new context and with fewer constraints, often leading to opportunities to redefine the ways we imagined teaching and learning with students. Alex adds:

> I just remember myself growing a lot professionally. In a sense—a lot of times as a special education teacher we focus a lot—talk a lot about physical barriers in the classroom. I actually had the opportunity to remove those barriers and see children flourish. Honestly, I couldn't even tell who had a learning deficit or not because when you remove the barriers and you provide something that models universal design for learning and everything like that, all students are able to participate.

As a teacher educator, I spend a lot of time talking about universal design, scaffolds, and making learning accessible for all learners. I have never worked with a pre-service teacher who said, "I don't want that. I don't want all of my students to learn." It is not a question of *desire* that is at the crux of the dilemma of what it means to create rich and meaningful spaces of learning for students. Rather, it is a question of *how* to do that, especially in a system that encourages a culture of constraint.

(Re)Defining Barriers for Learning: Reflecting on Elements of Space. Years later, as we reflected on ideas related to barriers, schooling, and space, Michael, Katherine, and I sat

together, reflecting on our experience. Katherine opened the conversation with thoughts about teacher learning and how a space such as this might contribute to it:

> I have the sense of…this idea of space. You know what I mean? This particular space where this all can happen… I just mean, like, there isn't space for this to happen necessarily at my school, the way that—the way it can happen in our space.

The "our"-ness in Katherine's description of the space is striking when considering our primary aim for this initial workshop was finding people willing to design an experience directly for pre-service teachers and students. Katherine's orientation of the space sets aside priorities of planning *for* others and instead points it toward creating a space of learning *with* others. For a few moments, we all talk at once as we respond to this idea. Then there is a pause, and I chime in:

> **SUZANNE**: The word I was thinking about…was autonomy. Because I feel like in this space, there's a lot more flexibility in terms of what we do than maybe in a school space. But it also makes it pretty rich in terms of having an opportunity for learning. Do you think that matches with what you were saying?
>
> **KATHERINE**: Yeah. I'm thinking, like a space of vulnerability, a space of—a space of trying things, a space of—we're here to support…teacher collaboration is such a crucial part—and not just…collaboration but teacher experimentation and supporting each other's experimentation.

Through this exchange we have shared a series of words used to describe this space—autonomy, flexibility, support, collaboration, experimentation—that are aspirational. As a team, we have seen glimpses of them in the work we are doing—certainly, the space hasn't been perfect, but it has been ours. Adding a new dimension to these ideas, Michael states:

> **MICHAEL**: You know, something about the space that I'm talking about, it's a physical space, the walls are down [as] we're working so you have more of an opportunity to support each other or it doesn't become competitive or evaluative….You're there with the—you see the people over here doing the thing. You see them over there and it's just very easy. But when you're in a school building…you actually have physical walls built—
>
> **KATHERINE**: you are totally pigeonholed, you know, and just completely isolated. Which is exactly how I feel this year.

The physical element of learning outside where there are no walls—where there is the security of being able to look over at each other at any point to ask for help—is a compelling metaphor that stands in juxtaposition to the popular image of the teacher working in isolation with their classroom door closed. Michael and Katherine offer an emotional component to these contrasting images as Michael's description of the team emphasizes "walls [being] down" where "there is an opportunity to support each other" while Katherine characterizes work in her school as sometimes being "totally pigeonholed" and feeling "completely isolated." The two further explain this juxtaposition and the implications connected to it:

> **KATHERINE:** When the new teachers are trying something new, we're there to support. If I don't understand the science, you're there to support me…And I think that when we want to experiment and we want to try new things and we want to dream big, we have to feel that there's community to support that.
>
> **MICHAEL**: You have to feel safe.

These comments emphasize and reinforce an experiential element of the learning happening with the team. Katherine talks about of learning of new teachers (e.g., "when the *new teachers* are trying something new)—which aligns with our previous aims and then expands on that idea to include her own learning (e.g., "if *I* don't understand the science) and how that can be supported by other members of the group (e.g., "*you're* there to support *me*"). She frames the common aims in connection with this complex network of learning (e.g., "we want to experiment…we want to try new things…we want to dream big') and then situates it within the community (e.g., "*we* have to feel that there's community to support").

At first glance, this particular notion of *space* may appear ambiguous and offer little sense of direction. It might be flexible, but flexibility toward what? People might be supported, but to what end? How could the design of a workshop tailored to the learning of pre-service teachers benefit teachers and schools? *Was* there a benefit to offering a space where teachers

could experiment with applications of principles of teaching and learning outside the structural and instructional assumptions of schooling?

In 2017, with the summer workshop completed, these were questions informing the genesis of the space. As we reflected on the experience, team members expressed interest in the possibility of experimenting with a new iteration of what had originally been an emergency stop gap. “Opportunities to take kids out of the physical classroom and the barriers that exist there, don't happen very often,” (Alex) and “we said, ‘we really like this…, why don’t we make it into a more formalized program?’” (Michael) add members of the team. We were already imagining the instructional strategies we wanted to prioritize and the experiences we were interested in designing—for us, as we experimented with our understandings of teaching and learning, and for students, as they engaged in these learning spaces. Elements that were a priority for various members of the team included “chang[ing] the way instruction looks and feels”, developing instruction that “go[es] to our strengths and will be really fun”, and making space for interrogating “unconscious assumptions” about what learning and teaching would remain central to the team’s work. A key aspect of these efforts included close considerations of our own teacher learning as we considered what features mattered most in designing spaces that would further excite student curiosity and build momentum in student learning. In thinking about this, we were already turning our attention away from prioritizing instruction that focused on factual content and pointing it toward refining our understanding and ability to create experiences for student experimentation. Katherine adds:

> There's this idea that somehow if I cover the curriculum, I’m doing the right thing because I need the kids to learn the curriculum. NO. You need the kids to care about the subject that you're teaching and want to do something with what they're learning. That's what the kids need: To be able to do something with what they're learning that's relevant and that's authentic. They need to see the purpose behind what they’re learning.

In seeking to create "relevant" and "authentic" learning, the team was thinking about ways to shift experiences from a series of isolated tasks that met the standard of "cover[ing] the curriculum" toward a more complex array that explored learning as a social and experiential practice—for both students and teachers. The group was attempting to more deeply understand how to establish a strong sense of purpose that would be situated at the center of learning. The team would be further exploring these ideas as our efforts veered toward transforming the learning space into a learning community. Alex explains:

> [T]he theme has always been community. It's always been about building a community… —recognizing that we're all part of a community and how do we sustain and enrich our community? That could be by us becoming better scientists, us being able to communicate with each other, us being able to design solutions to support our community, and not running from the responsibility that we have as community members….To me that's the word that's just threaded in everything…

Here, Alex frames community as both participation (e.g., "building a community") and contribution (e.g., "becoming better scientists, us being able to communicate with each other, us being able to design solutions…"). This conceptualization was already playing out in key ways for both teachers and students because community membership connected *being* in the community (i.e., a geographical space that encompasses the area where participants lived) with *doing* something together that contributed to the community (i.e., a group of people working toward a shared aim) and required enhanced development of knowledges, skills, and mindsets for both teachers and students to accomplish that aim.

For the individuals who made up the team, we were attempting to implement pedagogical approaches that embodied our developing understanding of relevance, purpose, authenticity, and inquiry—all ideas that align with common learning theories that are priorities of many teachers. In doing this, we wanted students to "recogniz[e] that we're all part of a community" and see themselves (and ourselves) as contributing and learning members.

However, having a vision of what one *wants* learning to look like and being able to *do* that learning with students are two different things. Members of the team needed a community where they could come to think ambitiously about how to enact those ideas in ways that extended beyond what they had already seen and done in the classroom and in this week-long experience. In participating as members of the team, teachers were building spaces where students could learn in community (as a group and in the geographical location of where they lived), and they were also building their professional space— as Alex put it, "a space for us to be creative and to generate ideas" and then to take those ideas and refine them through iteration.

As we continued our work, the program would grow with teachers joining what would officially become the Citizen Scientist Curriculum Team as they heard about and experienced the space. The space would shift and grow and we would eventually add a Citizen Scientist Instructional Team—teachers who wanted to join (and bring students) to participate in the summer experience but did not have the bandwidth to participate in planning. We would also come to add an internship program for undergraduate students in partnership with another local university. We were nurturing a seed that addressed a clear need of many within our community.

4.2 Creating Community for Ambitious Iteration

> All those different aspects about teaching are embedded in the Citizen Science program. Brainstorming ideas together – we have times where we would just brainstorm together with everyone. Then we would put a structure to the brainstorm and then we fleshed the brainstorm out. Then we would start to create an overall umbrella, like a scope and sequence for what we're doing. Then we build it out again and then we put the scaffolds in. Then we break it down by the day, and then we say, "Okay, what's the learning objective for each day?" and, "how is it connected to the overall goals of the program?" If you don't have experience doing that, you're not—you can learn it theoretically but learning it hands-on and seeing somebody working with you, alongside you. It's *project-based learning for teachers* because they're learning the curriculum development theory by doing it with one another, with a cohort, with a community.
>
> — Katherine

Project-Based Learning is a learning model that emphasizes connection to real-world problems, an active and collaborative process of critical thinking and problem solving, and the development of authentic products designed with a specific audience in mind (Buck Institute for Education, n.d.; Tsybulsky, & Muchnik-Rozanov, 2019; Kokotsaki, Menzies, Wiggins, 2016). For teachers on the Citizen Scientist Team, the real-world problem we had started to grapple with in the previous year was how to build a learning space that mirrored the work of scientists and also supported the learning needs of students. As this new year progressed, that problem would come to extend to intentional thinking about building a learning space for teachers as well.

It was early in the following school year when our collaborating team (Alex, Michael, Lauren, Katherine, and me) began to deliberate over the possibilities of a new and improved iteration of the previous summer's efforts. As we brainstormed possibilities for the upcoming summer experience, we discussed opportunities of maintaining contact with our collaborators at the local conservation alliance and considered the benefits of continuing the two freshwater data collection methods (water quality testing and macroinvertebrate collection) that had been piloted in the previous year. Lauren mentioned the idea of also adding a second location further south where we could work with students to collect data in brackish water (i.e., water containing some salt, but not as much as seawater) to offer a juxtaposition to data that was collected in our freshwater location. As we thought about strategies for culminating the experience, we also discussed the integration of a final project that could be shared with families and members of partnering school communities. In imagining these new additions, our ideas quickly began to bulge outside of the one-week timeframe of the previous year.

Because of the range of ideas we wanted to incorporate, the group elected to extend the program from one to three weeks. This would give us time to explore ideas deeply while

accounting for down time for teachers and students to rest and recuperate prior to the beginning of the following school year. In reflecting on the scope of changes that we were taking on, Alex remembers thinking, "okay so we're going to take what we did last year and now we're going to multiply that by three…How much work is this going to be? It's going to be a lot."

A lot in this case included planning and preparations that extended beyond building the curriculum content as both instructional and structural decisions became integral to the design. This was a learning experience that largely existed outside the boundaries of the school and partnering college structural contexts. This gave the group flexibility to interrogate even the most basic (usually predetermined) structural learning components, such as schedule. This flexibility was partly due to *when* (the summer when the course could exist outside of the typical school day) and *where* (next to the riverbank—a location where there was less school-based oversight and fewer established pedagogical expectations) the experience was happening. It was also a result of *who* (teachers and university-based teacher educators) designed the program and *how* (in the context of both pre-service teacher preparation and middle/high school student learning) it was built. Operating outside of even the most basic school-based constraints—for better or worse—removed typical decision-making baselines. One consequence of planning outside these structural limitations was the broadened range of decisions required that stretched outside those in a typical classroom. For example, while our team discussed the timeframe of the summer experience (i.e., extending it to three weeks), we were also making other scheduling decisions that, in a school setting, are typically predetermined. Michael explains:

> You have some of the structural things where…with, say, the Living Environment class, if I want to do [fieldwork]…it takes up too much of the class period and then I have to think about, "how do I logistically manage this?"….Now,…in my case I don't have many constraints with my administrators—they'd be totally happy with that (I know in others' schools it's a totally different case). But then I also have to go and start organizing with other teachers and may take from them. I have had times where I've taken kids on trips

> before where some of my peers—like teachers—have been upset that I've taken the students out of classes.

In this example, decisions are tied to the context of a common secondary-level school schedule that is based on the assumption that learning happens in 45–60-minute blocks of time as students move from teacher to teacher and topic to topic. This often leads to fixed blocks that are isolated and distinct from one another, which may result in an environment where developing learning experiences that extend beyond the period engender a sense of encroaching on other teachers. In his school setting, the idea of "organizing with other teachers" created a sense of tension for Michael as he worried about how he was "tak[ing] from them" or making them "upset." In this case, time was acting as a tool to divide and compartmentalize learning for both students and teachers. In the previous summer, Michael's natural tendency (even as a pre-service teacher) was to imagine learning through an experiential lens. He actively collaborated with other teachers to design and develop unified, place-based, hands-on inquiry where students were exploring the ecosystem. He was able to accomplish all of this in a community that functioned using collaborative norms. As a new teacher, Michael was already practicing professional processes of collaboration and was exhibiting extreme interest and capacity for this approach to teaching. However, his work in school revealed a much different approach as he experienced the school-based systems that limit teaching practice. While we know that collaboration is a key component of learning, we can see in Michael's experience how institutions of schooling can serve as a space that constrains attempts to enact these practices.

Planning for the summer resulted in a greater feeling of autonomy for the group as we re-thought fundamental structural components reshaping them to fit with learning needs. It also added to the workload of the project as we took on elements not typically considered during curricular planning. What we were attempting to do could have easily overwhelmed any

individual in the group but the ability of the team was magnified as the whole of what we were able to do became greater than the sum of possibilities had we acted alone. Having access to a collaborative community meant that the process of problem solving was not isolated which exponentially increased our capacity to work toward solutions. Alex states:

> I think the reason why it was successful…is that…we didn't find that we had…a blockade to an idea that we had….We came with an idea and the only reason we didn't go with it was because we ended up coming up with a better idea that was going to enhance teaching and learning. And we went with that. So, I think when you have the support and you have the beliefs behind you from your leadership telling you that, "yeah, anything is possible if you can come up to me with an idea," and then come be a part of that collaboration, then I think teachers will take more chances.

Our team had set out to create imaginative learning experiences for high school students and to involve pre-service teachers in seeing what those could look like. By doing this, we *also* created a learning space for ourselves, "a space for us to be creative and generate ideas." This context for creating and generating seemed to exist as an *in between space*, one where we were able to move past "blockade[s]" that might be experienced in both school and college settings. This is reminiscent of the processes of brainstorming and planning that Katherine and I had experienced with the NYC Detectives. Another space where people were imagining in ways where they felt that "anything is possible" and where it was necessary to establish processes of action that would move ideas beyond the point of conversation. Similar to the NYC Detectives, learning for our teacher team was happening in an informal context with a shared aim of, "enhanc[ing] teaching and learning." Because the space was pointed toward a concrete outcome of a summer experience that would be collaboratively shared, the group had an anchor to tie their ideas to while pushing outward beyond the familiar. This offered the opportunity to actively generate experimental elements of a new curriculum, rely on shared knowledge and strengths of individuals, while asking, "how can we pull this off?" as a unified group.

From the perspective of a teacher educator, I benefited from this space as it directly impacted the learning of the pre-service teachers in our program. In research on teacher education, there is a growing discussion of Third-space teacher preparation that emphasizes the development of "hybrid spaces" that "bring together school and university-based teacher educators and practitioner and academic knowledge in new ways to enhance the learning of prospective teachers" (Zeichner, 2010, p. 92). Through centering the potential pre-service learning that would happen by participating in the summer program our space certainly fit the definition of "bring[ing] together" members of both schools and university as we explored ideas of teaching and learning "in new ways." This was being done for the purpose of better matching *what we do* with *what we say* in pre-service teacher preparation as the residents participated in examples of project-based, student-centered, and inquiry-based learning. These are ideas they were beginning to learn about in their graduate-level courses and that they were sometimes experiencing in bite-sized pieces as students through the pedagogy of those classes. This experience offered a context where they were able to engage in the professional learning processes that aligned with those of teachers in the field who are consistently working to refine aspects of their practice. This included an element of experimentation that required all members (regardless of level of teaching experience) to be engaged in a process of trying out new ideas and making room for everyone to take up opportunities to contribute.

Meanwhile, for most members of the team, the matter at hand was less about pre-service teacher learning and was more about making a community "where teachers will take more chances" as they enhanced their own professional practice. While initially formed to solve a problem directly related to pre-service teacher programming, in the early stages of this second iteration of our work, we were forming a community that extended beyond those aims. It was a

community where we were offering "support" to each other as we attempted ideas that were new to us. It was a community we were defining in-real-time as we interacted within it, and as we did so, our identity as members of a team also grew. As we refined these new aspects of our community and developed a sense of ownership around them, we named the program associated with our community (formerly known as "that thing we did last summer") Citizen Scientist and our group took on the name of the Citizen Scientist Curriculum Team.

Becoming the Citizen Scientist Curriculum Team

In the spring of 2018, membership of our team began to shift. Lauren stepped away to prepare for a move to another city while the rest of us continued to imagine potential changes for the following summer. In remembering this time, which "brought whole new fresh ideas on what we could do and how we can make [this] really impactful," Alex remembers. The initial process included "add[ing] on additional members to the team" which happened over the course of the following year. Intentions for recruiting members to the group were not established in advance. Rather, the first instances of recruitment happened through word of mouth as teachers described their experiences to colleagues at their schools. Michael was the first person to recruit an additional team member to the team.

Working in a new context, Oceanside High School, Michael made plans to continue as a member of the Citizen Scientist Curriculum Team. "Without a doubt, it's energizing," he explained as he reflected on his decision to balance a continuing role in the group with the stresses of being a first-year teacher in a new school. As he worked to acclimate to his new role, Michael thought of his work with the team as a space for enhancing his professional growth and extending his practice beyond the boundaries of his new classroom.

As a new teacher, Michael entered a school with supportive leadership and an enthusiastic co-teacher. The context offered the kinds of structures and supports that are vital for a new teacher to be successful. Being part of the team offered access to a different sort of community where Michael was able to engage in professional learning by "bouncing ideas off of other teachers," "seeing how they actually teach," and building relationships with students outside the context of a classroom. This experience pushed Michael's thinking about possibilities of teaching and learning while offering supports reminiscent of those he experienced the previous summer. This was a space where Michael could continue to consider intersections between his growing pedagogical knowledge and his expertise as a scientist while reinforcing the enjoyable aspects of teaching which offered additional "energizing" elements to his practice.

In his first months at Oceanside, Michael immediately prepared to expand access of [Citizen Scientist to the school community. He introduced the project to school leaders and his new co-teacher, David. Meanwhile, the Citizen Scientist Curriculum Team brainstormed the necessary logistics for involving more students across multiple high schools in the upcoming summer. David became curious about the project and Michael soon invited him to be involved. Speaking of some of these initial conversations, "he started talking about it and then we started thinking about what it would look like to do that with our students from Oceanside," David explains. Soon, school leadership from Oceanside agreed to support the initiative and David expressed interest in officially joining the Citizen Scientist Curriculum Team.

Citizen Scientist offers one example of grassroots growth of a community. The process did not happen in a predetermined fashion. Rather, the early additions of a new partnering school and a member of the team are examples of organic expansion that represent members of a group who want to share ideas and experiences that are exciting, meaningful, and enriching with like-

minded individuals. In this case, it was informal conversations where Michael just "started talking about" his summer experiences that sparked the curiosity of David and the school leadership. This was a partnership that was forming because with Michael, a new teacher, acting as the initiator and lynchpin. Regardless of his prior teaching experience, he had the same autonomy and opportunity to invite others into the Citizen Scientist community. This type of organizing did not involve MOUs or other formal agreements. Rather, it was based on a shared interest in doing the work, work that existed within and between schools and the college because the people participating in the space represented those places. This process was also an important element in connecting the community to a concrete purpose of enacting the *project* (i.e., Citizen Scientist) of our group. As our team grew, elements of what mattered most to the group also began to emerge.

Like Michael, David was a graduate of the residency program. Now in his second year as a certified teacher, David was wishing for a space where he could experiment with various ideas central to his own vision of possibility in teaching and learning:

> I think for me it was really helpful to just have an outlet where I felt like I could do the type of teaching and learning that I was hoping to do, but outside the restrictions of the [Department of Education or outside the classroom. So, being a part of that team was really helpful for me to think about what would it look like to make education in the way that I would hope? Or in a way that I thought would be more helpful for students?

David's purpose of designing and implementing opportunities for learning that fit a context "outside the classroom" and that could "be more helpful for students" directly aligned with the team's evolving vision of the learning space we were working to create. His own ideas had been forming for some time. Thus, he envisioned the Citizen Scientist Curriculum Team as a community that had the potential to inform and reinforce his developing ideas. He continues:

> I'd been thinking a lot about students and their interests. Letting student interests drive the way that we were teaching…. Then also thinking about what it would look like to get hands-on, having lived experience…. And then as I started to get more of all the project-

> based learning, I was thinking more like, "What would it look like to do authentic project-based learning without trying to fit within the [end of year standardized] exam? Or fit it within a month-long unit? But really just give it the time that it takes and requires?"…. In the Citizen Scientist program instead, we were thinking more about, "what does holistic education look like?" and, "how do we make that happen here?"

The inclusion of David as a member of the Citizen Scientist team served multiple purposes that benefited him personally as well as the community as a whole. David's participation paved the way for Michael to learn to navigate his new school context and to successfully negotiate for students in the school to participate in the program. David already had relationships with school leadership and we all leaned on David in leveraging these relationships to achieve the aim of establishing a partnership. Meanwhile, David gained access to a community where he was able to explore ideas, as questions, and get good faith responses–in both theory and *also* through implementation– that he had been working through for some time. David's story of grappling with these ideas reflects the experiences many teachers have who often envision the possibilities of learning but lack the space and communal support to work through the *how* to concretely enact their vision. The power of this intergenerational teacher education community was not the *result* that could be promised. Rather, it was the opportunity to try to enact those ideas in the first place.

Interrogating Boundaries Between Teacher and Learner. The notion of who the "student" is within a given context is often quite rigid. However, we can expand opportunities for learning when we redefine those fixed boundaries and replace them with ones that are increasingly fluid. In the case of Citizen Scientist, the experience of being a student played out in different ways for members of the community—high school students participated in the three-week summer program, pre-service teachers learned as they assisted in summer instruction, and members of the Citizen Scientist Curriculum Team engaged in a much more sustained experience

of collaborative professional learning alongside each other. Furthermore, the Citizen Scientist Curriculum Team used the space to design layers of learning with members focusing on the experience through various lenses. For example, while David was considering "holistic education" for high school students, Katherine was thinking about similar ideas through the lens of pre-service teacher learning. Speaking of the pre-service teacher learning happening during the Citizen Scientist summer programming, she explains:

> It allows all these opportunities [for high school students] for language development and for practice that is really supported by a [pre-service teacher]. And the [pre-service teacher] can see that kind of excitement in that growth by seeing…learning opportunities where [high school students are] authentically acting as if they are scientists, or that kind of apprenticeship model, right, sitting beside somebody and learning with them.

This added layer of thinking about pre-service teacher learning offers a vital dimension that can enhance experiences of learning within a given context. Katherine was looking for new ways for her high school students to have access to "rich project-based activities" that allowed "for language development and for practice." Katherine could also see the mutual benefit of thinking intentionally about the work and learning of pre-service teachers. It is important to not just assume that pre-service teachers are able to see and understand what is happening by virtue of being in the vicinity of an experience. Rather, pedagogical design for pre-service teachers needs to include opportunities for shifting invisible teaching practices toward visibility. This is necessary even in imperfect moments, even when outcomes are messy, and especially when that requires significant vulnerability from teachers and teacher educators. For Katherine, this context could be used as a mechanism for pushing back against troublesome assumptions that come from "being schooled in how school is" that she often saw play out and that we needed to interrogate for ourselves.

Teachers need authentic mechanisms of learning just like students do. In order to achieve the most effective outcomes of learning. This means that teachers need access to learning spaces

that utilize strong pedagogical principles that align with those we would want children and young people to also experience. If we are focused on really understanding the practical applications of specific pedagogical practices, then we must be willing to engage in those practices as both teachers and students. As a team, we were interrogating our assumptions about teaching and learning and attempting to extend our understanding of what it means for students *and* teachers to have access to learning contexts that are exciting, rich, and relevant.

Project-Based Learning for Teachers: Inviting Pre-Service Teachers into the Community

From January through May, the Citizen Scientist Curriculum Team worked consistently to make preparations for the following summer. We met on weekends to design and develop an expanded curriculum based on our shared questions, ideas, and the experience of the previous year. Members of the team connected with their schools, negotiated logistics with leadership, and recruited students for the summer. By May, the group had developed a rough outline detailed enough to be shared with others, though rough enough to need more work before being used.

Meanwhile, a new cohort of pre-service teachers had been recruited to the residency program and were in their first semester of studies. January 2018 marked Riko's entrance into the residency program as one of these pre-service teachers. For Riko, spring experiences included spending time in Lauren's science classroom at Riverview where she observed and provided support to individual and small groups of students for an hour a day, three days a week. Along with the rest of the cohort, she also spent time visiting a variety of public schools—including Oceanside—in the local school district that were used as sites for observation, reflection, and introducing similarities and differences across school contexts and in connection to personal learning histories. The spring coursework was meant as preliminary groundwork, building toward summer experiences (including participation in Citizen Scientist) that served as a

preparatory foundation for the full-year residency that would begin in the fall. In the previous year, pre-service teachers participated in the enactment of our last-minute week-long summer workshop only during the week of implementation and, even then, mostly through observation. This year would be different as we attempted to frame the experience as a more intentional piece of culminating preparation for the fall residency—a context where each member of the cohort would work closely with a mentor teacher co-planning and co-teaching in the classroom.

Initial Citizen Scientist work was embedded into a required summer course for the pre-service teacher cohort as pre-service teachers were "invited into the conversation of the vision that was being created" (Riko). A main objective of the course was to introduce strategies of unpacking, designing, and implementing curriculum using the Citizen Scientist materials. In May and June, I acted as a coordinating facilitator for this work as other team members offered instructional supports filling the role of small group leaders. In July, as we implemented the curriculum these roles would shift as Alex, David, Katherine and Michael would take on instructional leadership while I offered logistical support.

From the beginning, the summer course became an intentional opportunity for Riko and the rest of the pre-service cohort to practice and engage in actions of professional contribution and academic risk-taking while considering what mattered most to them as teachers and learners. These are elements that would eventually grow to be vital in Riko's own classroom and that aided her development as a creative problem solver. Reflecting on her initial experiences with the planning process, Riko adds:

> [I]t's very…different from the type of school setting…I had been used to seeing or being a part of. This idea of being able to do school outside within the community…it's an exciting idea to work with. And then being able to talk to teachers who have been working on the curriculum…and people in the residency program. It was a nice space for me as someone who is…science-focused and just starting out…. It was really nice to be

> able to have that sort of communication and collaboration. I felt like that helped me to develop even further…as a teacher and…to identify what I wanted to see in the future.

In this case, some of Riko's first experiences *being schooled* as a pre-service teacher introduced her to new narratives of what teaching and learning can be. These incorporated elements that she had not experienced in a formal school setting such as "do[ing] school within the community" which served to extend her range of thinking about possibilities for learning by expanding her experience. The university often acts as home base for much of the course-based learning that pre-service teachers experience. The structure of this experience flipped assumptions about pre-service teacher learning and instead emphasized pre-service teachers being invited into the teacher community. This resulted in the pre-service teachers becoming members of the team and participating in the real collaborative actions that aligned with the work that the curriculum team was already doing—work that was experimental, pedagogical, and professional. As someone "just starting out and learning about education in general" this experience provided a model of collaboration that reinforced Riko's own vision of what she "wanted to see in the future." This also modeled aspects of teaching and learning that incorporated elements of community organizing such as being invited into a community space and engaging in deep collaboration that leads to the implementation of a concrete action. Additionally, this context of teaching and learning set the stage for Riko to think about what it meant for her to engage in a professional teacher learning process that happens alongside other teachers. A process that included the development and implementation of curriculum that would be collaboratively enacted with students from partnering schools.

To offer an additional perspective, three NYC Detective consultants Maria, Ivan, and Victor also joined the sessions on evenings when they were available. Each student was partnered with a small group consisting of a member of the original curriculum team and a few

pre-service teachers. The club members offered a student's point of view and advice about plans that were being made. Including students in the planning process was a necessary element (that grew over time) in the work of the Citizen Scientist Curriculum Team. This element modeled and reminded pre-service and in-service teachers the importance of accounting for student voice in planning. Additionally, this purposeful structure created a new context for NYC Detectives members to engage in pedagogical conversations that enhanced their own thinking about learning processes.

Inevitably, this planning process included times when pre-service teachers witnessed and experienced curricular realities when "things get a little bit messy", seem "ambiguous", or are "super confusing" as another pre-service teacher, Dan described. This process of professional engagement in the community offered an opportunity for ideas and expertise to be shared from multiple perspectives as we collaboratively aimed for an early pre-service teacher experience of developing *real* curriculum that would be implemented with *real* students in an effort to foster *real* learning for all. Riko adds:

> With this approach, I feel like I got more exposure to collaborative teaching. I feel like that was the impact of what was happening was that—that was my first time—well, first time interacting with curriculum. But also, first time thinking about it in terms of it's not just me, but thinking about it from multiple perspectives, or teaching perspectives.

Working alongside the teachers offered a space for Riko to consider her own ideas of curriculum, identify opportunities to contribute, and be introduced to prospects of learning and perspectives of teaching that she may not have otherwise considered or seen as tangible possibilities in her own teaching practice. The Citizen Scientist Curriculum Team was inviting pre-service teachers into our newly forming teacher learning space. This offered the opportunity for all to explore how communication, collaboration, and teacher community *could* play out as we were sorting through and attempting to enact those possibilities.

During each course session, pre-service teachers spent time in small groups contributing to the development of aspects of the curriculum. Alex led one group focused on creating learning scaffolds, David worked with another that identified activities that would be embedded into the curriculum to support relationship building, Michael's group identified strategies for reinforcing student understanding of scientific concepts, and Katherine's focused on building language supports for participating English learners. As a member of Michael's group, one of Riko's contributions was an activity designed to help students better understand the concept of a watershed, "an area of land in which all water drains to a common location or waterway." (McCallie, 2003, p. 17). The activity involved creating a watershed model using a crumpled piece of paper (to represent land) with lines drawn in water soluble ink (to represent mountains and ridgelines) and a spray bottle (representing rain). Contributions from the pre-service cohort, such as this activity shared by Riko, were refined in class and embedded into the curriculum. This process was vital as the ideas of various members of the group were incorporated as they were encouraged and affirmed.

A central facet of project-based learning is the deep and interactive process of interrogating real-world problems including complex questions that have no easy answers (Buck Institute for Education, n.d.). Here, as we collaboratively created curriculum, we envisioned students participating in processes of real-world problem solving while we were also enveloped in our own process of project-based learning for teachers as we considered complex questions about teaching and learning and prepared to apply them in the upcoming three-week program. The hands-on contributions of the pre-service teachers in these weeks were an important aspect of this as the materials we created together would be implemented in the weeks to come.

(Re)imagining Assumptions of Learning: Shifting Perspectives of Teaching and

Learning. Working alongside new and experienced teachers who were actively reimagining their own conceptions of teaching and learning offered a context where pre-service teachers could interrogate assumptions rooted in their own experiences of schooling. Riko, for example, began reflecting on assumptions about why and how students interact in the classroom. This began with considerations of her own experience as she describes, "I know I've always been someone who's super terrified to ask questions because I thought that other people would think that they were not good questions, that I wasn't smart, or I wasn't paying attention."

Asking questions in the classroom may not be experienced as "terrifying" for all students, but for Riko it was academically risky as she protected herself from the potential shifts of others' perception of her as a student. In internalizing these unspoken messages, Riko modified her actions in the classroom, filtering questions based on the context thereby reinforcing these behaviors as she progressed in school. As she collaborated in Citizen Scientist as a curriculum maker, Riko began to interrogate the role that question asking could potentially play in the classroom and began to consider how the possibilities she saw might run counter to her lived experience. In her role as a student, Riko's expectation for learning was limited to knowing the right answers which, without reflection, would likely translate into a similar boundary of learning in her teaching. In the Citizen Scientist context, Riko tried new ways of making space for question asking—for herself and for students–expanding her conception of what is possible. This broadened perspective also contrasts with Riko's experience and educational conditioning in a higher education context. She continues:

> [I]n …undergrad courses, you're taking a course that's with hundreds of other students. It's nerve-wracking to ask questions in front of everybody….[T]hen it becomes—like if we have questions we go to these office hours, which is great, like that's an area or a space for us to be able to get support, but then it's still like, "Okay, we asked questions in a hidden context or hidden space that gives more space and it doesn't require so much

> vulnerability being a person who's like, "I don't know what's going on," or, "I need support," "I don't quite get it."

When it came to question asking, Riko's own range of experience in her previous schooling led her to experience, "a stigma around asking questions" that was associated with fear rather than with the possibility for exploring the unknown. She needed a space to investigate other possibilities for implementing and engaging with this element of learning. As Riko participated in different and less familiar pedagogical approaches related to question asking during the summer, her personal experiences–past and present–informed her thinking about the potential needs of students with whom she would work. She was considering how she would position expectations for "right" and "wrong" answers and how these may reinforce or alleviate feelings of anxiety. She was critically reflecting on the implications of sending spoken and unspoken messages–would they leave her classroom thinking that intellect is associated with knowing the "right" answers or would they develop a sense of the value of engaging in the act of asking questions—especially questions that may not have answers? Here, Riko was unlearning beliefs she had about the role questions play in instruction as she also developed a more nuanced sense of the role questions play–for scientists and students–that came to align more closely with principles of inquiry-based learning. Supporting teachers as they reexamine rooted norms and ways of thinking that are common in learning experiences is vital in helping them identify beliefs and assumptions they are holding about teaching and learning. Teachers have often spent most of their lives as students in a school setting. This act of "making the familiar strange" introduces teachers to new ways for reconceptualizing learning processes in ways that push beyond their own histories and into a mindset where they are instead considering possibilities of learning that are anchored in the interests, strengths, and needs of the students with whom they work.

Still, Riko's previous experiences in school left challenging habits that she continued to interrogate as she experienced in-real-time responses to teaching situations. Riko explains:

> So, if you're coming out of that sort of setting of being someone who's afraid to ask questions then you're imagining yourself as being that person who's supposed to be in charge, who's supposed to be knowledgeable. Then you have a question and there's still some hesitancy around showing students, "I don't know," because you feel like you should be that person who does know.

Riko needed an opportunity to redefine her conception of learning by experimenting with and practicing new teaching and learning strategies so she could *experience* how these new ideas would play out. In her mind, Riko might have *known* that taking the risk of asking a question is an important element in student learning, but the *habit* of experience formed an automatic response that told her that, especially as the teacher, she was the one who needed to have the answers within the classroom. Riko might also have *known* that she needed to enact learning-focused risks in her teaching practice to grow pedagogically and to model academic risk-taking for her students. However, enacting the *skill* of taking learning-focused risks in an isolated context could quickly become a heavy load if she were stuck alone holding the burden for identifying, testing, reflecting, and taking responsibility for the outcomes of a new practice without the support of others. Engaging in a process of interrogating and reimagining habits for learning and teaching in community was one way to alleviate some of that strain while providing space where we could all figure out how to replace old practices and assumptions with new, updated approaches. Riko concludes:

> So that's something that takes time and practice to gain comfortability around. I think an explicit way—or being explicit about it at least starts to build that sort of idea that it is okay to not have the answers. The students are going to be okay. That's it as well… because we also want to build those practices within students so it's an opportunity for modeling that I think we often forget about.

This sense of grace, knowing that "it is okay to not have the answers" and that "[t]he students are going to be okay" is reminiscent of Lauren's realization from the previous year that

"it's okay to step back." Riko was developing comfortability to trust in the learning process and, as Lauren described, "watch the learning happen and facilitate the learning instead of swooping."

Co-Constructing Opportunities for Learning. As a teacher educator, much of the pre-service teacher coursework in May and June was improvisational. Each week I would walk into class thinking that this might be the night that everything fell apart. More than once as we were in the midst of class, I would sometimes turn to members of the team and sat, "I don't know, what do you think our next step is?" genuinely hoping that someone would have an idea. This context, fraught with uncertainty, was also a place where we were practicing elements of collaboration as we ambitiously considered how to enact this new, scaled up iteration of last year's last-minute experiment. Pre-service teachers were actively engaging with an array of teachers to enact fundamental principles of teaching and learning with an eye toward long-term development. The process of this project played out as a complex network of learning between all. Katherine recalls:

> That makes me think about all the different levels in which teachers, or pre-service teachers, are participating in a program like this. That idea of creating curriculum together, unpacking it together, preparing it for instruction together, then enacting it together, reflecting on the enactment together and then going back around to do that again and again offers this really scaffolded, supportive learning environment for teachers…. [And] they're supported by teachers that have more experience…that will be able to connect the dots for the students in ways that maybe the [pre-service teachers] aren't seeing the overall picture yet.

In this case, those processes were intentional as the pre-service teacher cohort participated in the planning and unpacking of the curriculum that was to be implemented in the coming summer. Those side-by-side contributions illustrate a context where multiple layers of learning are built on top of each other as everyone works toward a common outcome. The group offered a "supportive environment" as various members bringing different levels of teacher experience aided each other in "connect[ing] the dots" to provide an "overall picture" of where

we were going. In doing this, the original team members placed trust in the pre-service teacher cohort and benefited from their imagination and insights that contributed to building the final components of the curriculum. Concurrently, pre-service teachers trusted the big picture of the curriculum team—things might seem a bit "messy," but members of the group had confidence in the direction where we were headed. This example of engaging in a planning process as an intergenerational teacher education community offers insight into the energy and enthusiasm that can be generated from this sort of creative context. We often teach pre-service teachers about the theoretical aspects of teaching methods such as project-based learning and encourage them to make space for students to engage in these processes of learning. In this case, we were attempting to apply that understanding as we created a community of professional learning for us all—"project-based learning for teachers."

Safety in Numbers: Community Risk-Taking. Through the years, these complex behaviors of teaching and learning have been practiced by the team time and again through iterations of planning and implementation of Citizen Scientist. That process has not been perfect and has often been messy and even a little chaotic. At times we have started down one path, hit a dead end, and have had to retrace our tracks before coming upon feasible options in our work. For the group, these practices have been most successful when members of the team felt "supported" and "safe." These are key factors that have been fostered in the team and that encourage instructional and collaborative risk taking. They have contributed to the transformation of the team from a set of teachers working together to organize a workshop to a community creating a learning space used to experiment with their own and others' ideas of teaching and learning. Riko, Michael, and Katherine elaborate:

KATHERINE: It really feels very different.

RIKO: Well, there's also like a—you're sharing the risk.

KATHERINE: Yeah, you're sharing the risk. I like that idea.

RIKO: Because within your classroom if the lesson that you plan for didn't go exactly as expected then it feels like it fell on you as opposed to a community or a collaborative group.

KATHERINE: Right, yeah, and when you are sharing the risk, you're willing to take a bigger risk.

MICHAEL: And also the fall is different, I think…because the risk in the classroom is if you're being observed.

RIKO: Yeah, there's that too.

MICHAEL: Right? And then you're like, "oh, crap!" …I fell on my face on this one… whereas at [Citizen Scientist]: one, you have the support if you fall on your face, but two, it's accepted that it's—this is learning, the teachers are learning. So as long as we reflect on it afterwards, and then learn from it, we're good. We'll just make it better next time.

In this exchange, there is a distinct contrast between the impact of "being observed" in the context of the classroom and Michael's description of "support" and "the teachers…learning" as the group reflects on engaging in the risk of creating opportunities of learning for students. This subtly nods to a difference in *purpose* for sharing practices between the Citizen Scientist and school contexts.

In the context of school, the group characterizes the purpose of sharing practice as *oversight* and describe decision making that limits the risk of failure (and ambitiousness of instruction) as teachers protect themselves against instructional imperfection. "If the lesson that you plan for didn't go exactly as expected" there are consequences that are associated with *oversight,* leading the teachers to "feel[] like" something that does not go to plan is negative and that "it fell on you" to avoid that failure. The group's characterization of the consequence of instructional failure—"the fall"—offers a constraining position where failure should be avoided at all costs and is professionally detrimental. In the context of the Citizen Scientist Curriculum

Team, the purpose of sharing is to push each other forward and to work as a unit. This is work that is being done *with* each other and aligns with the shared aim of improving everyone's professional practice. In this sense, the group is "sharing the risk" as they collectively work to improve their practice. Where one person succeeds, so does everyone; where one fails, we reflect and "just make it better next time."

By nature, a risk is a situation where the outcome is unknown—these are the moments where a "frickin' disaster" (Katherine) is possible, but just as possible is a mighty success. If success were guaranteed, then *there would be no risk*. Risk taking is a normal component of the work of the Citizen Scientist Curriculum Team which means that failure is as well. However, in this context, where we are "sharing the risk" of enacting our ideas, the consequence of instructional failure is "reflect[ing] on it afterwards, and then learning from it." In recognizing this process, we have come to embrace the *imperfections* of our teaching practice. A pre-service teacher once asked me about this mindset. She was worried that if there was not an expectation of perfection then there would be no reason to keep on trying—but this all depends on what replaces that expectation of perfection. The notion of having "support if you fall on your face" sets aside the notion of perfection and replaces it with endless cycles of learning and refining. This is driven by shared aims for practice—in the case of the Citizen Scientist Curriculum Team, that is a passion for supporting the development of rich, hands-on, project-based student learning. That ability to take risks is one that the team has honed over time. It is also one that the tends to be associated with trust in the team. Over time we have become more comfortable with the idea of risk taking and sharing our practice as the outcome of instructional performance is tied to on-going learning rather than perfection. It has been built into the fabric of our experience of learning and matches with what Katherine describes as an "assumption of our program" that

"learning happens socially." Yes, this is true for students, and it is also true for teachers. For the team, teacher learning can and should be a social practice.

In Spring 2018, as we were engaged in the initial evolutionary processes of the Citizen Scientist intergenerational teacher education community, an opportunity of *un*- and *re*-learning was beginning to emerge. For Riko and others in the pre-service teacher cohort, this process included time to reflect on familiar forms of teaching and to consider their impact on conceptions of what matters most in a learning context. It also offered new experiences that felt unfamiliar and that aligned with the curriculum team's own critiques and sensibilities for creating positive learning spaces for students with whom they worked. For everyone, the newness of what Citizen Scientist offered served to disrupt assumptions of teaching and learning in ways that pushed the group to consider elements that might previously have been seen as mundane (such as question asking) through new eyes. More than a discovery of a magical utopic answer to teaching and learning, this process resulted in an increased sensibility of purpose in teaching practice. This process incorporated aspects of making the familiar strange as we interrogated elements of pedagogical practice and extended our conception of the range of pedagogical possibility by developing our capacities to enhance professional decisions designed to attend to the strengths, interests, and needs of those in the learning context.

Imani: "Regaining Hope in Education." In June, the Citizen Scientist Curriculum Team recruited a final member for the year, Imani. A graduate of the residency program who had just completed her first year of teaching, Imani was part of the same pre-service teacher cohort as Michael. As her induction mentor, I had been working with Imani over the course of the past year offering supports as she began her career as a newly certified English as a new language (ENL) teacher. After graduating from the residency program, Imani, "had all of these wonderful

ideas about all the things I could do–and then I got into the real world." Imani had accepted a position at Forrester High School, a school that was considered "failing" by the local school district and was now working to figure out how to navigate this new space. In reflecting on this decision, she remembers, "I made a critical decision that I was going to go to one of the worst schools in [the city] because I wanted to see…how realistic is change in this environment?"

Imani's teaching schedule split time between co-teaching with a veteran Living Environment teacher and independently teaching English classes to students who were English learners. With the school undergoing a significant transition, Imani was one of several new teachers hired while many long-time veterans spent the year preparing for retirement. As a whole, more experienced teachers at the school were tired and demoralized while new teachers came with very little understanding of the context they were entering. Having completed a full-year residency, Imani was more experienced than the rest of the school's newly hired English as a New Language department, all who were in the midst of completing teacher preparation programs. This meant that she was also continuously asked to take on the additional task of filling leadership roles in the school.

Imani found an ally in her Assistant Principal who was also her direct supervisor. She was supportive and enthusiastic about the ideas Imani proposed around enhancing professional learning of the ENL teaching team and advocating for the needs of English learners in the school. However, more often than not, these ideas would be quietly side-barred by more senior school leadership in favor of flashier initiatives that would bring more attention to the school. Imani adds:

> So, I went there and—it was just as bad as I thought it was. But I didn't think it was going to be as disheartening as it was. And I didn't think it was gonna take the mental, physical, and just intellectual drain that it took on me to conform to this system that was inherently racist and continuing oppression.

By spring, the pressures of the situation and responsibilities in such a "disheartening" context had started to take their toll. Reflecting on the situation Imani adds, "I was depressed…it was an extremely depressing situation…. [A]ny idea that I had would get shot down for some arbitrary reason. I think that you saw that."

This situation where new teachers enter schools with a personal vision of what it means to engage in the profession of teaching can often be met with frustration as they experience disequilibrium in their attempts at realizing the ideas they have spent so much time developing. Among others, two reasons for this are the lag that is inherent when knowledge of what is being attempted is ahead of the skill needed to do it. A second is misalignment between the school environment and the new teacher's vision of their role ((Wall, 2018).). In an unsupportive and dysfunctional school setting those challenges are magnified especially as a "failing" designation can easily come to be interpreted in a way where students are blamed for school performance. However, it's not the students who are failing school but the school that is failing the students.

Imani spent her first year of teaching in a context of impossibility. Her attempts to solve even the simplest problems were met with explanations of why "that's not possible." As I continued to work with Imani, I became increasingly concerned about the sustainability of the situation and started to mention the idea of pulling her into the Citizen Scientist Curriculum Team. Joining the Citizen Scientist Curriculum Team did not change this situation, but it did offer a first step in regaining some of the hope that she had lost. Here, she could more flexibly explore her own vision for teaching and learning in collaboration with others who shared a similar vision:

> I wanted to provide [English learners] with a really fun environment to learn language and…I was like, "this can be done through science." And then Citizen Scientist popped up as an opportunity and here's Katherine who also has the same thing—like the same goal and the same desire that I have, and here's Alex who wants to do this for students

> [with ability differences], and here's David who wants to do this through project-based learning, and then here's Michael who knows all about this science and is actually doing some of this stuff on a smaller scale in his school. And then like here's you who can facilitate…the opportunities that we wouldn't have in our schools….[Y]ou invited me to do it because you knew I needed something to regain hope in education and—just why we do what we do.

Imani had spent a year pushing back against school personnel who voiced doubts about her students' capabilities and desire to learn. She needed time to teach without simultaneously fighting for her students' right to learn. In the context of Citizen Scientist, Imani was able to set aside these tensions and focus on figuring out how to effectively create rich, meaningful learning experiences with teachers who shared "the same goal and the same desire." The desire did not mean that the team had the answers necessary for developing a perfect context for learning, but the common goal of the group did mean that each member had a desire to engage in the dilemmas at hand by pushing in a similar direction.

There is only so much positive impact that one isolated teacher can have in a school, especially when their efforts flow against the norm. In that context, maintaining any level of professional momentum requires teachers to have access to a positive source of sustenance (Moore Mensah, 2019). This is especially true for teachers of color who often face an added layer of microaggressions and racial hostility that they must navigate for themselves and with their students (Kohli, 2019). These mentally, physically, and intellectually "drain[ing]" contexts are a major factor in situations that end up pushing teachers out of the classroom. These are situations where teachers of color are unheard, and their ideas are not represented, even in their own work (Moore Mensah, 2019). In situation like this, (pre-service) teachers of color "cannot find [themselves] within the curriculum, conversations, and student teaching [or teaching] or experiences" and end up feeling "discourage[ed]" and "frustrat[ed]" or even punished in their attempts to enact strong and sound pedagogical practice (Moore Mensah, 2019, p. 1444). Imani

fortified herself against the "dehumanizing" (Kohli, 2019, p. 29) experiences that she faced in her school by reaching outward and joining a "like-minded community" (p. 40) where she felt heard and experienced opportunities for her ideas and contributions to be anxiously enacted in collaboration with others.

As a member of the team, my invitation to Imani came through informal conversations—similar to Michael's invitation to David. The process was organic as I described the group's experiences and suggested that she join. As a teacher educator, my invitation to Imani was strategic as I was thinking about how her participation in the group might offer access to an alternative teaching space and additional teacher supports that could alleviate some of the stresses she was experiencing in her current teaching context—a way "to regain hope in education." As a White teacher educator, I don't always have the foresight or insight to successfully recognize and align supports to the needs of (pre-service) teachers who are in my sphere. In this instance, the Citizen Scientist Curriculum Team offered a mechanism for me to extend support beyond my personal ability as Imani came to a space where she was able to work alongside, learn from, and eventually mentor other teachers in the community. The Citizen Scientist Curriculum Team was coming to function as a community that could offer collective support to those who were part of it.

As a member of the Citizen Scientist Curriculum Team, the invitation for Imani to join the group was similar in nature to the one offered from Michael to David as it represented a member of the team finding someone who might share a common interest in this work and wanting to share the experience more broadly. Working with her Assistant Principal, Imani and I made arrangements to recruit a small group of students from Forrester High School to participate

in Citizen Scientist. With this last team member of the Citizen Scientist Curriculum Team, we made final preparations for our first three-week iteration of the program.

Implementation: Stepping Out of Our Comfort Zone

The team's next step was implementing the plans we had created which offered a different sort of challenge as we now attempted to enact the ideas that we had envisioned together. Between the collaborative contributions of the pre-service teachers and our own continued planning efforts, by July, the Citizen Scientist Curriculum Team had firmly planned our first week of instruction, had a general sense of what we would be doing in the second week, and a vague idea of the possible processes we imagined implementing as students developed projects in the third. The enactment of this second iteration of Citizen Scientist (the first in its three-week form) began on the second Monday in July.

Now a significant aspect of the residency program, this was also the first time we had implemented such a time intensive pre-residency learning experience. Due to concern about overwhelming the pre-service teachers, I struggled with my own comfortability of requiring that pre-service teachers commit to participating in the full three-week program. Because of this, the Citizen Scientist Curriculum Team, in conversation with the pre-service teacher cohort, decided to require pre-service teacher participation three full days each week with each pre-service teacher choosing which three days they preferred. This requirement came with an added invitation for members of the cohort to join for any extra days that they wanted. Because of her availability and general interest in the program, Riko was one pre-service teacher who participated for the full five days each week.

In reflecting on her experience, Riko remembers, "we just kind of jumped into it" as she thinks back to the initial days of implementation. She adds, "I still felt hesitant…like, "okay, I've

been working with this curriculum, I know what it looks like on paper, but then what it looks like to actually act on it, I don't quite know, it's kind of an unknown." Crossing that bridge from "what it looks like on paper" to "what it looks like to actually act on it" was a key element of this experience for everyone. The Citizen Scientist Curriculum Team was pushing ourselves to take risks and attempt things we had never done before and were hoping pre-service teachers would come to see this as a central element that they would become accustomed to implementing in their own practice. We were aiming to create a rich but decidedly imperfect learning experience that would hopefully alleviate some assumptions of concrete and complete contexts of learning and replace those with a context where "we can practice and try" (Riko). For example, speaking of the watershed activity she contributed in the May/June curriculum design phase of the project, Riko adds:

> [O]n the first day it's like, "Riko, do you want to take the lead on teaching or on going through this watershed demo with the students?" And that was the first time I'd ever stepped in front of any group of students and taken the lead on something. So, I was really nervous. Going into it, I was also around so many supportive people that were able to help me and support me in leading that activity. So, I think that initial experience then helped to set the tone for the rest of the experience as well and helped me to continue to think about ways that maybe I'd be stepping outside of my comfort zone.

This moment, another first for Riko, set an on-going norm of "stepping outside my comfort zone." It was Michael who approached Riko to suggest that she step in at this moment—just a year earlier he had been in her shoes as Alex and Lauren modeled this practice of making space to try out the curriculum they had worked together to develop. Now, with little time to think as students were already waiting to get started, it was Riko's turn. As the contributor of the upcoming activity, Riko had a vision of what it could be. Others were also in the room to offer encouragement or step in if she ran into trouble, which offered a safety net as Riko "stepp[ed] outside of [her] comfort zone. This was an opportunity for Riko to discover "what it looks like to actually act on" what she had been part of developing and explore "an unknown."

For everyone, the enactment of the program was a bit of a step (or possibly *leap*) into the unknown. By inviting pre-service teachers to join us in taking that step, we were offering a model for teaching through learning as the Citizen Scientist Curriculum Team was also figuring out what instruction looked like in this space. Dan, another member of the pre-service teacher cohort describes his own experience in this circumstance:

> I remember feeling a little stressed and being like, "We don't have a curriculum what are we going to do?"…We had a general idea of where we were going and where we were aiming to end but we hadn't quite fleshed all of that out.… [F]or me, it was almost a hybrid situation where I was kind of a student and sort of learning the curriculum as it was being developed.

Contributors in this context required different levels of support as they "jump[ed]" into the experience. Some were thrilled with the plunge headfirst into the events of the day while others needed a bit of time to dip their toe and acclimate to unfamiliar waters. Whether opting for a plunge or toe-dipping, the environment offered experiences and reflections that helped us all think about what has happening, how students were responding. We were also using our reflections to make plans for what could happen next—in the next moment, the next day, or the next year. In reflecting on his own experience iterating on this curriculum, Dan offers additional insight as in his first year participating in the program, he began to plan for participating in a second iteration—with the second cycle offering new understandings. Dan adds:

> Then the following year even though we were still…redeveloping it and fleshing it out and building it more, I had a much clearer sense of like, "okay here's where we want to go, here are places that were weaker last year, here's where we can really solidify things.

Through his experience, Dan was developing a "clearer sense" of the learning happening as the curriculum was enacted. He was also thinking about how current practices might apply in subsequent situations. Yes, this initial experience left him feeling "a little stressed" and—as he took up ownership of his own contributions to the experience—he knew there would be time to reflect on and make the program better as we went. This process of iteration offered an

opportunity for members of the group to take up the pieces of the experience they understood, turn them around, and apply them in the moment while leaving room for new understandings as members of the team (including pre-service teachers) looked to the coming year.

Seeing Students through a New Lens. For teachers who had taught or would be teaching the same students in the following year, the experience of working with them in Citizen Scientist offered moments of new awareness and appreciation as students participated in learning in a new context. Michael reflects on his own previous misconceptions:

> [O]ne of the things [participating in Citizen Scientist has] done for me is…take certain misconceptions I might have about what certain students might be able to accomplish based on what I see of them within the four walls of a classroom. And then I'm seeing that same student…over the summer…just go out and have a fun time,…students who I saw in school who were not engaged.

Seeing learning happen in a new context offered new evidence that Michael was able to use as he formulated assumptions about (dis)engagement, (dis)interest, and (un)motivation. In education, we talk about the vital work of recognizing students as *whole people* who have many ideas and strengths that can be contributed to the classroom community (e.g., Carini & Himley, 2010). However, for most secondary teachers, the reality is they see their students in just one context and rarely have the opportunity to interact with students outside that very narrow context. Michael, was now watching students in a new context. He remembers:

> I'm thinking of one [student] in particular that I wrote a recommendation for afterwards, [Jeremiah]. I had originally had him in Living Environment and he would rarely show up to class, just very infrequently. Then when we did Citizen Scientist, he was trying to increase his credit load…I said, "yeah, you could get a credit for this, come on, you can join."

From his work with [Jeremiah in the classroom, Michael had formed a very specific image of him. One of absence that led to assumptions about [Jeremiah's interest and intent to do well in class. During the time in the summer, Michael came to see a student who, "was very determined, he was 100% engaged out in this environment." This new view led Michael to

"realize that students that don't necessarily respond as positively within the school…have wonderful gifts and they have the ability to do—that they just might need different opportunities."

At one point during the three-week session, students met with a local city councilperson to talk about some of the environmental work already underway in the area. This discussion left a lasting impression on [Jeremiah and when it was time to develop final projects, he decided to write a letter sharing data he had collected with the councilperson. "He was coming every day and was enthusiastic about what he was learning and what he was doing," Michael continues. This experience left a lasting impression on Michael causing him to more closely consider assumptions he was forming about students with whom he worked and approaches to learning he planned for the classroom. He adds:

> Seeing that side of [Jeremiah], I was able to take that experience, bring that to the classroom that…students that may not be as engaged in school or in my class, they often have a different side of them that I'm just not seeing and there is potentially a way to get that out into the classroom or potentially out of the classroom….It's made me think about how I can try to bring those opportunities within the four walls of the school…[and] try to remove those walls.

As pre-service teachers interrogated their assumptions about teaching and learning in Citizen Scientist, so did members of the curriculum team. As a first-year teacher, Michael was confronted with his misconceptions about students and their motivation and capacity for learning in the classroom. In July, witnessing markedly different outcomes of students he taught in school acted as a catalyst for considering a "different" and sometimes invisible side to his students leading Michael to shift his approach to school-based instruction.

Challenges Seen and Unforeseen. Admittedly, scaling Citizen Scientist from one to three weeks, from seven to over forty high school students, and from one to multiple locations all while looking for ways to embed pre-service teachers into the mix was a recipe for messy

moments and stressful situations that were not always fixable in real time. It was also an opportunity for us to test our limits and to imagine new ones.

The first week of program implementation represented the second iteration of last year's summer workshop. In this week, we worked with students to complete water quality tests using the same kits as the previous year as well as collecting and categorizing macroinvertebrates as a second indicator of the water's health. As a team, we each had specific experience and expertise we were contributing to the group. At the same time, we were also learning with and from each other. This included spending time in meetings asking Michael questions about local water systems. Additionally, most of the team also spent time working with members of our partnering local conservation alliance to reinforce our understanding of the content. Michael may have now been the only certified science teacher on the team, but he wasn't the only person who could learn about our local water systems or have conversations with students about them.

The following week we shifted our attention down river to a new location situated on an island that was accessible by ferry. As we initiated this second cycle of data collection (this time in brackish water) noticeable gaps in our plans began to emerge. Our intention for this site was to include a second iteration of water quality testing so students could look across the data and discuss similarities and differences. Our second data collection method (collecting and categorizing macroinvertebrates) would not yield useful data in brackish water so instead we opted to spend time collecting and analyzing data about oysters living in the area—a vital organism that contributes to the health of the local ecosystem. Nearly every aspect of this second week was new and presented unforeseen challenges. This put particular pressure on Michael who could more easily improvise as he drew from his much more extensive science background to inform his teaching. Still, he was working to learn how to break complex ideas down for students

and this year he was missing Lauren's support which had been vital in the previous year as he puzzled through this process. Other members of the team were able to offer support to an extent, but by this time Michael's isolated expertise placed him in a lonely situation as he tried to explain his ideas. At one point in the week, I looked over at Michael who was staring into space with a look of overwhelmed bewilderment and worried about whether we would make it through to the end of the program—I wondered if in our ambition we had bitten off far more than we could chew. Reflecting on these moments, Katherine states:

> [O]ne thing I think [we] learned…pretty quickly [is] we were trying to do too much that … year. And it was a wonderful experience for the kids, the kids learned a lot, but we learned very quickly, "oh, here's the things that we need to scaffold more for these kids…" So, we were both discovering that together.

Though challenging and certainly far from perfect, as we pushed ourselves past our limits these moments became vital in helping the group extend the boundaries of what we imagined we could do. In many ways, it was the moments that followed these stressful situations that mattered most because they represented an acknowledgement that there were lessons we could learn if we approached them with a critical eye and from a perspective of iteration. We were positioning ourselves as learners who had the ability to make what we were creating better. In doing this, we were giving ourselves grace in the moment and were also thinking about how to continue to develop our ideas. Katherine continues:

> Then we made the program better for the following year…so it's like trying something together…. [L]et's come up with this idea and then we're all there participating in the activity and we're all there and reflecting on it on a daily basis. And then at the end, we can look at…everything that we've done together. We're doing it together instead of just by myself in my classroom doing this alone. I have the reflective ability that's multiplied exponentially of being able to look at what was difficult.

In the moment our instruction was sometimes messy—even chaotic. There were structural and instructional components that were missing. Sometimes students were confused and as teachers, we weren't always sure how to support them. Sometimes the pre-service teachers were *also*

confused and the team was often equally uncertain about supporting them. Still, by approaching the situation through a dual lens of what was happening now and what that means in terms of what we will do next, we were able to look past muddled instruction toward challenging questions of what we needed to change to enhance the learning and teaching in the space. This approach introduced an idea of *intentional iteration*—we were experimenting with our practice in anticipation of providing a meaningful experience in the present and identifying what needed to be changed for the future. This process was "multiplied exponentially" (Katherine) as the team pulled from each other's experience to solve both immediate and long-term problems. Katherine adds:

> [R]emember, we always had the science checks—"is this scientifically valid?"…We had the person there to say this. We had Imani and me there saying, "oh this language stuff is way too much for the kids. We can't just show them pictures. We have to have the pictures labeled." …So, then we created more scaffolds and supports…. [I]f we didn't have all those people there we wouldn't be able to enhance it in the way that we did.

These points of reflection were pedagogically important. They were also vital in building a mindset of trust in each other and the process of learning we were experiencing. On a daily basis we talking about the things that were working *and* we were able to look ahead and consider how we might try again in the coming days and in the following year.

Years later, Katherine, Michael, Riko and I reflected on this experience as we talked about the important role that professional collaboration plays in mitigating the stresses of these situations. By this time, the frayed emotions of the moment had long since passed and were replaced with nostalgic humor:

> **KATHERINE**: can you imagine trying to develop the whole scope and sequence of everything by yourself of what we do at Citizen Science?
>
> **SUZANNE**: No
>
> **KATHERINE**: There's no way.

SUZANNE: Can you imagine trying to enact what we do by yourself?

KATHERINE: No, you couldn't, right?

Riko laughs. Speaking of himself, Michael adds—

MICHAEL: No. I remember that one year, we had one science person.

Michael laughs as others chuckle at the memory.

SUZANNE: You barely survived!

MICHAEL: Yep. I came out with one leg.

Michael adds this wryly, but it is actually true as Michael started experiencing a flare up of an old foot injury in the midst of the three weeks. The group sits for a moment in silence, remembering the experience. Then Katherine adds—

KATHERINE: I remember one time I went over to Michael and I said, "what are we doing next?"

MICHAEL: Oh, I remember that

KATHERINE: And he was like, "I have no idea!!!"

Everyone laughs at this. Still laughing, Michael adds a—

MICHAEL: Sorry.

KATHERINE: I was like, "wow, I need to step back a little bit here."

The laughter increases.

MICHAEL: Yeah, sorry for that.

SUZANNE: It was good to learn though. Then the next year, we recruited a bunch of science teachers.

The laughter in this exchange is especially telling as we talk about moments that, at the time were particularly challenging. In this case, we seem to have managed to turn these stressful situations into memories that fit into a positive and active view of the work. Many teachers have stories from their careers of what Katherine calls "teaching traumas." In a different conversation, this time with Alex, Katherine defines what she means by "teaching traumas", "like people that you've worked with that just caused trauma for you. And you're healing from it." In looking back

on this inaugural year of the three-week version of Citizen Scientist, stressors and challenges included, trauma was not the outcome of this situation. Katherine continues, “there's absolutely no traumas that happened in Citizen Science where I felt like we worked through something so difficult.” Alex agrees with this sentiment adding, “I think that's why we can like—it doesn't sit with us. Because it's all healthy, you know, what we're experiencing and what we're going through.” This surprises me because in my own reflections I wrote about worrying in these moments, not for myself but for the team. My concerns came from uncertainty in how people were experiencing our engagement in the messiness of our experiments. I worried that someone would just throw their hands up in the air and say, “I give up!” This was especially true as we entered the third week of this iteration of the program.

Conceptual Clashes: Dilemmas in Defining Program Outcomes. As the third and final week of the program began, a new challenge presented itself to the group. From the beginning of our planning, the Citizen Scientist Curriculum Team had anticipated having students develop culminating projects that would capture different aspects of their learning, but we had not settled on what that would look like. Some imagined the focus of projects pointing toward reinforcing the skills associated with data analysis as we worked with students to delve into the scientific data we collected and analyzed. Others envisioned an opportunity to imagine potential environmental solutions—strategies for enacting change that would be immediately relevant to the priorities and interests of the students. Both arguments were valid and connected to priorities shared by all members of the group.

Elaborating on the perspective that prioritized culminating activities meant to reinforce skills students had been practicing, Alex explains:

> [G]iven where our students’ language needs were—just their development in terms of academic vocabulary…they weren't going to be able to meet that next step of providing

> solutions when they were just trying to understand the core content ideas or understanding how to analyze data. And that was where we kind of shifted our focus.

As described by Alex, the priority in this instance was meeting "our student's language needs" and considering where they were in their learning. In this situation, the idea was to spend time making sense of the fieldwork that had happened over the previous two weeks, delving more deeply into making sense of the data based on the scientific concepts that had been introduced, and mirroring the process of data analysis that would be used in scientific research. In this approach, students would spend most of their time connecting concepts with data they collected, develop a visual component to their project (usually a poster), and draft a scaffolded lab report that explained the data collection process and preliminary findings. This approach specifically centered the needs of the English learners who were part of the student group. Many had been learning English for a year or less. Their new content-specific language had grown significantly in the past weeks. This was a chance to push their understanding and language development even further.

Expanding on the perspective that prioritizes a focus on the development of potential environmental solutions, David explains, "[I]t still felt very much like there was a right and a wrong answer rather than true inquiry where there's multiple pathways to being able to be able to finish your projects." As described by David, the priority in this perspective was to offer "multiple pathways" that would extend the boundaries of possibility for students to illustrate lessons learned and make recommendations from the data they had collected over the course of the last two weeks. David continues:

> [W]e were trying to figure out like, "Are we here for the data gathering? Are we here for the science aspect of it? Or are we here for the teaching and learning aspect of it from, I don't know, more of a culturally responsive lens?" Rather than like, "oh there's the correct answer and do this."

In this situation, the aim was to task students with developing a culminating project that offered a solution to a problem that the students had identified through the previous two weeks of data collection and analysis. Students developed a range of projects including public service announcements, video games, and a letter to a local councilperson. Here, there were few parameters on what the students would create offering opportunities for a wider range of options as students took ownership of their final projects.

Neither of these potential pathways were wrong. Instead, they represented differing ideas about the purpose of the culminating assignment. They also centered the needs of student participants in different ways—one focusing primarily on skill and process while the other focused on relevance and application. This was a tension that represented differing possibilities grounded in what mattered most for different members of the group at that moment in time. Ultimately, this disagreement turned to conflict that ended in a division-by-school compromise.

Over the next three days, the teachers from Riverview and Forrester met with "their" students, nearly all English learners, at Riverview and worked with them to reinforce skills while developing a visual and scaffolded lab report. Meanwhile, the teachers from Oceanside met with "their" students, nearly all students missing science credits who were participating in the program for purposes of catching up on graduation requirements, at Oceanside and developed projects that addressed solutions to problems they identified over the course of the first two weeks. Pre-service teachers were evenly and randomly assigned to both groups. In this situation, one conflict bred another and by presentation day, the dissension in the Citizen Scientist Curriculum Team had fostered decreased communication between members of the group. This led to miscommunication about where, when, and how presentations would happen. In the end,

the two groups hosted separate showcases in two different rooms starting at two different times in the same building on the island where we had collected our second cycle of data.

As a teacher educator, I remember watching this communication breakdown and feeling concerned for everyone. How were the pre-service teachers faring during this time? Would the Citizen Scientist Curriculum Team ever be able to work together again? I recognized that by this point we were all tired and that certainly was not helping the situation. Yet, as the program came to a close, this was an ending that none of us had envisioned.

An exhausting three weeks had been filled with ups, downs, and opportunities to identify a range of strengths and weaknesses in this summer experience. We were wrapping up final presentations with frayed nerves and feelings of frustration over several aspects of the program, especially in how things ended. Alex remembers, “We didn't like the way that it felt. We hated that we split each other up and we were seeing differently on what the final product was.”

We were ending our second iteration of Citizen Scientist in unresolved dilemma. Despite this, members of the Citizen Scientist Curriculum Team were leaving having gained enough that they were willing to not give up on what we had created together. Even with the challenges at hand, as David put it, one of the “best things” to come out of the experience was “the relationships between teachers and students that were developed.” These are things that members of the team were holding to that were informing their decisions to keep on trying.

Reflections on Iterating Ambitiously. On the final day of our July programming, once presentations had ended and the dust had settled, pre-service teachers took the lead in organizing routes for commutes, loading students onto the ferry, and accompanying them on their various subway rides home. The Citizen Scientist Curriculum Team found a table at the island’s outdoor café and watched as students and pre-service teachers boarded the ferry. It had been a long three

weeks, but we had made it through, only slightly scathed. Now we sat at a table, knowing that we needed some time together to talk and settle the air. Sitting around the table, eating and drinking together, helped deescalate frayed feelings as we gently talked about our three-weeks of hard work. In general, eating (and in this case, drinking) had become an important component of our rhythm and in this moment, it served as a sort of reset. “We ate together a lot—we always ate food together and we stopped working, and we just—…I think that's what also made it fun because we're like, ‘wow we're making this thing that's going to be used and the kids are going to love it,” Imani explains. In this case, this moment of communal pause helped us to reorient and remember those aims that we all shared. We knew we needed to make changes, big changes, but we were also remembering how much we trusted and appreciated each other. We had bumped up against problems that we didn’t have the energy to solve in the moment, but our trust and appreciation allowed us to feel confidence in pausing and, as Alex put it, letting it “spill[ ] into our planning the following year.” We were ending knowing, “We all wanted to work together, and we trusted that we would all be equally contributing to making this goal happen… we trusted each other's expertise,” Imani remembers. Here in this final moment, the team was already planning and looking toward the coming year. Initiating this process of reflection helped alleviate some of the pressure that had been built over the last days of the program leading to a recognition that there was a lot of work that needed to be done in preparation for next year.

In this case, existing in between school and university contexts was a factor in supporting members of the group to step outside the conditions of their regular work to consider and focus on professional learning away from the structural and cultural norms of those places. This was specifically important for members like Imani who was experiencing considerable discouragement as she attempted to push back against the rigid structures of her school. The

space offered refuge, affirmation, and hope, especially at moments when these elements were missing from the full-time professional contexts of members of the team. The group was using Citizen Scientist as a context where they felt sustained—especially in light of constraints and barriers emerging in full-time professional settings. Because members of the group were working in different contexts, when dilemmas emerged that related to specific constraints, the group was able to pool our varied experiences to brainstorm potential solutions.

The team also offered a context for engaging in deep, reflective processes of complex, real-world problem solving (shifts in teaching/learning) that pointed toward a specific aim (the summer experience) for a particular audience (student participants). Mirroring principles of project-based learning, these elements offered an opportunity for the group to grapple with ideas that were salient to their own learning. The process, however, did not lead to a tidy outcome that we may envision when we think about the project-based learning process. Instead, we were left with more questions than answers.

4.3 Embracing the Reset: Strengthening the Citizen Scientist Team Dynamic

> We all were able to focus on one mission. We were able to trust each other and work off of each other. There wasn't really any competition for whose ideas [were] the best. It was always “yes, and,” and then “yes, and” became something better, and then “yes, and, and, and” became something better. We would start with this one idea, but then everyone would just put in another ingredient that would make the idea better than the initial thing we proposed. I think that's because we all trusted that we all wanted the same thing.
>
> — Imani

Collaboration is an element of teaching practice that has been shown to positively impact student learning in multiple areas including reading and mathematics achievement (Hargreaves, 2021). Yet, schools often offer few if any spaces for teachers to practice skills of collaboration or to coordinate their own thinking and learning in real time. If teachers aren’t fostering these collaborative strategies in themselves, then how can they teach them to students?

Just as is the case with any other set of skills, collaboration is not an automatic result of tossing a few people together in a room. Teachers come to schools with different levels of experience, desire, and preparation for intensive collaboration. Furthermore, actions meant to encourage collaboration in a school setting (e.g., meetings where tasks to share the workload are assigned) tend to encourage practices that are counterproductive to collaborative habits that support shared thinking, reflecting, designing, and teaching as a team. Even when time is set aside for teachers to collaborate, many leaders predetermine the purpose for the time limiting important agentic elements that constrain teacher's abilities to engage in the creative generation of ideas. "Other [leaders] want to colonize collaborative efforts with purposes and activities other than ones teachers might initiate themselves" (Hargreaves, 2021, p. 7). This leaves little space for teachers to refine their own professional capacity for collaboration.

One framework studied by a group of researchers found general differences in people's approaches to collaboration based on culturally-specific tendencies. These tendencies result in children having varying amounts of access to settings where they engage in (and thereby practice) approaches to collaboration. For example, some cultural paradigms tend to enact collaboration as "bridging and negotiating between distinct, divided individual perspectives" (Ruvalcaba, & Rogoff, 2022, p. 2). This approach prioritizes a division of labor as one of the main functions of working together. This contrasts from other cultural paradigms that utilize practices of, "work[ing] together with flexible coordination building on each other's ideas with shared decision making and pliant leadership" (Alcalá, Rogoff, & López Fraire, 2018, p. 11379). An approach that highlights the practice of *sharing thinking* as a key component and that, "organizes ideas of social relations and processes of learning around a view that individuals inherently engage together and that learning is a process of *transformation of participation* in

social endeavors (Ruvalcaba, & Rogoff, 2022, p. 2). These tendencies toward or away from a form of collaboration that encourage division of labor versus shared thinking are reinforced through interactions in the home and school.

In schools in the United States, children tend to lack opportunities to engage in most forms of collaboration with division of labor being far more common that shared thinking (Rogoff, 2016). When considering the lack of collaborative spaces for teachers within school contexts, the absence of collaboration that emphasizes shared thinking in the classroom should not come as a surprise, but it should be an element of concern, especially considering the possibilities for learning associated with strong collaborative practices.

In the case of the members of the Citizen Scientist Curriculum Team, instances of collaboration were not often experienced in the schools where they worked. Structurally, these schools weren't set up for engaging in or practicing collaboration, especially a form of collaboration that would encourage practices of shared thinking. This practice requires time for building trusting relationships between colleagues that connected to a sense of shared goals and values. It also requires time be set aside for long conversations and space to grapple with instructional dilemmas. Instead, in most of these schools, interactions tended to focus on dividing tasks, working in isolation, and one person taking on ownership of creating materials for larger groups. When the culture of teaching teams is set up in a way that is isolating, then teachers tend to not engage in collaborative behaviors or mindsets, and this limits opportunities for teachers to experiment with and develop skills related to collaboration. Michael offers one illustration of this:

> When I come to the school I'm prepping already for my class that I'm teaching that day, I'm teaching what, four of them plus maybe some other classes. I'm also prepping for advisory for a bunch of other teachers and things like that so that they have the content. I'm running around like crazy to get all of this stuff done, or prepped, or organized, or

> planned, or graded…there is always so much more to do. When, for instance, when we did those retreats we planned, and then we had down time, we talked and stuff like that... It's a different kind of environment.

For Michael, school is a place that is inherently individualistic. He is arriving and working through a list of tasks that he is completing independently. Some of that work he is doing *for* other teachers, but it is still happening alone. The *pronoun* he uses to describe this work is a resounding and isolated *I. I'm* teaching, *I'm* prepping, *I'm* running around like crazy. There is a marked difference in Michael's description of his participation on the Citizen Scientist Curriculum Team. In the passage above, he refers to one event, a retreat, and in describing it noticeably shifts his language: *we* planned, *we* had down time, *we* talked. As the team's community continued to develop, this orientation toward a sense of *we* offered an important foundation for the approach to collaborative planning and learning in the coming year. It also emphasized a sense of shared ownership in efforts to move forward with our aim of refining our work.

For the Citizen Scientist Curriculum Team, an element of intergenerational-ness also surfaces within the group's collaborative efforts. A debrief with the Citizen Scientist Curriculum Team and pre-service teachers where members of the group reflect on implementation of one program iteration offers an example. In this instance, one pre-service teacher had been describing observations of a student noticing that during instruction, "he's so quiet and reserved even though he's not like that with his friends" and wondering what it looks like for him to learn in a typical classroom setting because, "he doesn't necessarily get it in the same…pace as the other students." After some brainstorming about how to address the instructional needs of this specific student, the conversation shifted as David adds a structural perspective that addresses elements of the group's learning experience. In the conversation, he begins with a recognition of the value of this brainstormed conversation and offers that, "that's a really powerful observation and one

that classroom teachers…aren't often thinking [about]." He then shifts to consider how our own processes within the Citizen Scientist community might be modified to include more of these opportunities:

> I'm thinking one of the things we're missing is more structured opportunities like that. What are the [pre-service teachers] doing as they're assessing student growth and development or their own abilities as teachers or teachers in training. I'm thinking more about structure in their experience.

Here David is thinking about high school student supports and he has extended his lens to focus on the learning of pre-service teachers in the program. The ideas and observations of one pre-service teacher are acting as the specific catalyst as David discusses a gap and the structures that need to be added for the experience of pre-service teachers to be enhanced. While his comments are noticeably geared toward specifically toward individuals who fill specific roles within the community (.e.g., high school students and pre-service teachers), his words also make space for others in the group to apply these comments to the learning of all. With David's encouragement, Imani is the first person to make this leap:

> *Imani whispers something inaudibly to David*
>
> **DAVID**: Imani has a great idea that she whispered to me.
>
> *Imani looks at David with a playful glare*
>
> **DAVID**: Imani, say your idea to everybody.
>
> *The group, including David and Imani, laughs.*
>
> **IMANI**: Or even like structured opportunities for us to talk about students. So, like if we—if someone does notice that, right, like I don't know how early on you noticed that, but then we have a meeting…and we're talking about students, and we can pay more attention to [the high school student], and make sure he is copying things down correctly. Everyone's on the same page so we can…meet his needs as well.

Here, Imani is considering potential implementation of David's idea while also extending it from a few members of the instructional team to the full group. She has taken David's main idea and

using small shifts in her language illustrates a pivot from "them" to "us." Where David talked about "*they're* assessing student growth" and "*their* own abilities as teachers" Imani subtly extends accountability for who will do this by including "opportunities for *us* to talk about students," discussing how "*we're* talking about students," and "*we* can pay more attention." This shift gives everyone in the room ownership over making a change and provides space for anyone to suggest how that change might happen. The shift aligns with a message that we trust the shared nature of this space and are working to give credence to the ideas and opinions of all who are in it. In this circumstance, it is another pre-service teacher who next makes a logistical recommendation for operationalizing these ideas:

> I also think…more time to debrief after each day because I know it's kind of hectic at the end of the day…we're all running and anxious to get home. It's been a long day, but I think, like, we need that debriefing time to able to discuss things like that.

Here, Imani's communal pronoun choices are reinforced as recommendations for potential strategies for addressing the situation are made. This pre-service teacher is cognizant of potential challenges that may be connected to her approach but emphasizes the importance of taking this time to be able to effectively support students while providing a meaningful experience for teachers. As the group comes to recognize and take note of the importance of carving out this debriefing time each day, the element is recommended not because it is a requirement set by someone else or because that's "what you're supposed to do." Instead, it has been identified as an intentional strategy devised to meet a particular need of the group as we collaboratively find ways to address our shared goal of better supporting student and teacher learning.

In this circumstance, contributors who have the least experience as teachers in formal classrooms are playing the role of pushing everyone to interrogate how we are thinking about collaborating to support the individual needs of students. This begins with observations that may seem familiar to more experienced teachers but are seen through a lens of newness by pre-

service teachers and then is extended with ideas of more experienced members of the team. Theoretical, structural, and reflective aspects fit into this discussion of opportunities for learning and concrete next steps are woven together into the conversation.

At moments of introspection, members of the Citizen Scientist Curriculum Team have often talked about how different this collaborative work is from other contexts. This was especially true in moments when we were engaging in this process of collaborative critique and reflection. In my own reflections, I have imagined that an outside observer's interpretation of what they might see in our team could be easily compared to a department or grade-team meeting in a school. I once asked Alex about this similarity. It was something I had been thinking about because my own experience in other contexts bore a comparable aesthetic but often lacked a similar sense of rigorous conversation where it felt as though all individuals around the table saw themselves as collaborative contributors who were sharing in the efforts of creating something together. Outside of this context, I have noticed my own reticence to speak my mind and advocate for ideas that I knew would enrich learning of students with whom I worked. Alex described a similar reticence to "ruffle too many feathers" that he sometimes felt in school:

> I didn't want my colleagues to think that I was going to be difficult to work with, so I'd rather have been easier to work with but my students weren't going to get the best instruction…I think I was afraid for [my ideas] not to work out. I think I was afraid that if I advocated hard for something like this to happen and we did it and then it didn't work out, I wouldn't have another opportunity to do it because I didn't have the data to prove it…for myself.

In the Citizen Scientist context, collaboratively reflecting and then critiquing *in community* was a vital component of this process. Building in space for "those reflection opportunities" (Katherine) increased our ability to be patient with our own process of learning and "taught [us] how to be vulnerable" (Alex) while pushing the boundaries of our ideas. The growing expectation of the team was that our implementation of the project was never going to

be perfect. Instead, the space offered opportunities to iterate on our design. This meant that we were always in some stage of a cycle where we were making new decisions about what matters most right now for learning, developing plans based on our understanding of the possibilities in front of us, and considering how we might think beyond our current perceived limitations. Alex concludes:

> It was just continual planning and addressing those areas where we could have been a little bit stronger in our instruction, we could have been better in our planning, or we could have been better in our logistics. Every year it got better because we got a chance to reflect on our mistakes…. I was always held accountable with [Citizen Scientist] but I knew my accountability stretched far enough to be where I would have the opportunity to fix those mistakes.

In the upcoming 2018-2019 planning and implementation cycle of Citizen Scientist, this approach to our own learning would be vital.

Refining Foundations: Evolving Collaborative Practices in Teacher Learning

A survey of artifacts representing events and gatherings that led up to implementation of the third Citizen Scientist cycle (see Table 4.2) illustrates an extremely busy planning process as we worked to address discovered gaps and refine instructional approaches in the program's development. The trajectory over this period was not intentionally mapped, but looking retrospectively at a series of meetings and activities, patterns emerge that illustrate an evolution of efforts as ideas built on each other, one informing the next. The group oscillated between discussions reflecting on what we had already learned and visioning new possibilities as we asked, "what should we do now?" while moving from one meeting to the following.

Table 4.2 offers a description of Citizen Scientist Curriculum Team actions over the year—including approximately 45 distinct team interactions (e.g., planning meetings, site visits, retreats, field trips, orientations). An analysis of artifacts (e.g., meeting notes, documents created, calendar descriptions, photographs) across the year offers insight into a general trajectory of

reflection and visioning. The focus of these interactions shifted, sometimes vastly, from minute to minute within a meeting and from week-to-week. These efforts were informed by a shared desire to reimagine Citizen Scientist in ways that accounted for lessons we learned in the two previous iterations of planning and implementation that were leading to an emerging cycle of experimentation, implementation, and reflection.

Citizen Scientist work happened *only* in-person and together. It was rarely structured around a formal agenda and instead meandered back and forth across a range of conversations extending from highly theoretical discussions focused on big ideas to mundane pedagogical logistics—the pragmatic and detailed processes necessary to implement a program (e.g., completing fieldtrip forms, negotiating across multiple school administrations to gain support for the program, initiating correspondence with potential community partners). In many ways, these tasks mirrored the day-to-day work of a school context, but they were experienced differently as the work shifted from individual toward collaborative efforts. The time was used for side-by-side work as the team generated and tested ideas. Tasks were completed in real time and in community, with any work that was not finished being set aside for completion when we were back together again. To balance bandwidth, our aim was to do work together and, at the end of the meeting, set the work aside to be collaboratively continued at another time. We were sharing the work of fostering our abilities to investigate, experience, refine, and create pathways for learning and in doing so were refining understandings and practices of collaboration.

Contributing to the Space: Membership in the Citizen Scientist Curriculum Team

As a new cycle of planning and implementation began, so did recruitment efforts to the team. This resulted in the addition of three new members: Victor, Torben, and Marisol. Along

Table 4.1 Prioritized Actions in the 2019 Citizen Scientist Cycle

Time Frame[1]	August	Sept-Oct	Nov-Feb	March-April	May-June	July
Outcome[2]	Rest	Reflection	Vision	Plan	Preparation	Implementation
Focal Activities[3]		Evaluating Critiquing Describing Analyzing Imagining	Refining Imagining Calibrating Networking Expanding	Brainstorming Normalizing Decision Making Connecting Problem Solving	Developing Testing Recruiting	Decision Making Improvising Experimenting Practicing
Actions[4]	No Actions	Planning Meetings (3) Teach to Lead-San Jose (2 days) Team Recruitment	Planning Meetings (10) January Retreat (3 days) Site Visit (1) Team Recruitment	Planning Meetings (6) Site Visit (2) April Retreat (3 days) Intern/TA Recruitment Host Int'l Visitors (2 days) TA Orientation (1 day)	Planning Meetings (11) Site Visit (1) HS Recruitment Field Trips (3) Intern Orientation (1 day)	Planning Meetings (3) Site Visit (1) Implementation (15)

NOTE: Focal activities shifted over time and were informed by the actions implemented during the full planning cycle. When looking across artifacts that represent different points in time, patterns of purpose emerged that resulted in sequential and evolving outcomes.

with interest in sharing efforts in our Citizen Scientist endeavor, a key factor in defining membership of the community was presence and participation—if you were interested in being part of the team and wanted to do the work we were doing, then you were invited. Presence and participation were vital aspects in the space because they represented necessary ingredients for the group to work side-by-side, in community, and to build a history of shared experience and learning. Our aim to add members to the team were also pragmatic. In addressing the gap in science teacher expertise we found in the previous year, we knew we needed to add at least one teacher with science expertise.

In addition to alleviating pragmatic pressures, adding members meant potentially introducing new depth of perspective to our planning process. In the previous year, David and Imani had joined our group and were able to jump into the planning and instruction with relative ease. However, their decision to join the group was a matter of *coming back* as they were both graduates of the university residency program. In joining the team, their membership in this already existing community was extended to overlap more specifically with their school relationships and responsibilities. David and Imani characterized the process of joining the group as an almost predetermined sense of sharing the "same goal and the same desire" that was grounded in "similar ideas of what education could look like and should look like" which aided in a sense of "align[ment] in what we were hoping to achieve in the program." This alignment contributed to a general sense that "we were all able to trust each other" that was connected to feelings of "friendship" between members of the group. It also fostered trust that members of the group were "going to be able to [do the work] with the same integrity." Even in conflict, these elements anchored the group allowing space for dissent, disagreement and, when necessary, an opportunity to regroup. Now as we identified new members to recruit to the team, we were

venturing outside the small circle of [residency program graduates and mentors while attempting to maintain these aspects of trust and camaraderie that were the foundation of the team dynamic.

The intergenerational nature of the Citizen Scientist Curriculum Team pushed our understanding of who might be interested in joining the learning space—and the implications of that participation. The introduction of each member into the team aligned with moments that were also integral in strengthening and reinforcing the team's collaborative dynamic. The following sections offer both individual and collective descriptions of these experiences through *zooming in* on the process of Victor, Torben, and Marisol as they joined the team and *zooming out* to explore the collaborative dynamic of the Citizen Scientist Curriculum Team as members were added.

Zooming in on Victor: "Widening My Eyes." Now a high school junior, Victor was already participating in most activities of the Citizen Scientist Curriculum Team and the regularity of his presence acted as a natural point of induction to the group. The team had already been involving students in planning and implementation of Citizen Scientist. Now, with Victor formally joining the team, this practice became formalized. "The team needed a student's perspective," Victor explains while discussing his decision to join the group. In considering the intergenerational nature of the team, Victor's framing of his role in relation to what the team needed is significant. He was being invited to join the team with a mutual expectation that there was something he could contribute that was just as important as the rest of the members.

Victor's purpose for participation as a member of the Citizen Scientist Curriculum Team bore striking similarities to other members and was grounded in his desire to "have other people in my community have the opportunity of having hands-on science." These contributions aligned with his personal "love" and "deep appreciation" of science. As a student attending the same

school as many Citizen Scientist participants, Victor appreciated his teachers and the learning that happened in the school context. He also recognized an opportunity gap in what experiences students had access to and felt passionate about contributing to the development of enhanced spaces that extended learning in new ways.

Victor "assist[ed] with the curriculum building…[and] helped with logistical work—making sure staff had the resources they needed, making sure…students had the materials that they needed." Like other members, as Victor's participation continued his contributions grew with his role evolving to match his interests. This came to include "leading other teaching assistants" who had previously participated in the July Citizen Scientist experience as students and were now coming back with the new responsibility of supporting instruction.

In keeping with group norms, Victor's participation included dual roles of teacher and learner. Victor was coming to the space thinking about student learning through the lens of being a student and was directly contributing to plans that would impact access his friends and peers had to new experiences. As he drew from his collaborative experiences as an NYC Detective, being a member of the team provided an opportunity to build on his existing experiences as he gained insight into potential the collaborative processes of this new context. These intersections informed his conceptualization of possibilities in learning as he formed new ideas of what it means to be a teacher:

> Even though most teachers in high school have to follow a certain frame of teaching… even though there [are] certain guidelines you need to follow, [learning] can be as interesting as you want to make it. It's like a puzzle. You can complete most of the puzzle…[and] get the image, or you can use all types of pieces and basically fulfill the greater picture…make it as interesting as possible.

Victor was joining in on our shared endeavor to see teaching through a lens of possibility. A result was coming to see instruction as a "puzzle" with the possible pieces offering opportunities for learning that could be "as interesting as you want to make them." Victor's introduction to

teaching included elements that are often interpreted as constraints to instructional design (e.g., standards or "a certain frame of teaching"). Still, his experience of these elements was in the context of a creative space where they were being used as a tool that resulted in non-traditional instructional outcomes. He saw instructional decisions such as "get[ing] a textbook out" to talk about macroinvertebrates versus "get[ing] firsthand experience and then learn[ing] as we're looking at them" as intentional pedagogical decisions. One leading to a general sense of an idea and the other a deeper understanding of the "greater picture." These are lessons that Victor was learning as he worked alongside teachers who were puzzling with dilemmas of enhancing the experiences of students and broadening the scope of learning. They are possibilities that he came to believe in as he saw and contributed to them. They "widened my lens of how teaching can be," Victor reflects. He was coming to recognize a sense of agency in planning that led him to conclude that "teaching can be as interesting and as fun as you make it."

Victor offered perspectives that pushed the group's ideas about intentionally incorporating student voice into processes of curriculum design and teacher learning. The central focus of a teacher's work is directed toward actions that are meant to facilitate the learning of students. Teachers think about what we will do for students, what we will ask them to do, and how they will take on the responsibility of their own learning. In a classroom space, we may ask students for feedback as we consider how to build future iterations of their learning. Teachers may also talk about the things that we learn with and about students as they engage in experiences and activities we have devised in their student learning context. Victor's membership on the team differed from these elements of classroom learning. His positionality shifted from being with teachers in a *student* space to entering a *teacher learning space* and becoming integral

to the work and learning that happened there. Being part of the community did benefit him, but the reality is that we probably learned more from him than he learned from us.

Zooming Out on the Curriculum Team: Teacher Leadership Summit. Early in the 2018-2019 planning cycle, we learned of an opportunity to participate in a teacher's summit designed with the aim of "informing, developing, and implementing education policy and practice to steer systematic improvements that benefit student learning" (Office of Elementary & Secondary Education, 2019, "Teach to Lead" section). The idea of having a dedicated space to imagine and refine Citizen Scientist seemed inviting and aligned with the planning we were already doing. "The thing about being in a strong community is that you go out and you find your resources that you're going to need to help you," explains Katherine, and this was an example of one of those resources. The due date for applying to this summit was a few days before the upcoming second cycle of Citizen Scientist implementation. Because the team was occupied with plans for this, Katherine and I met as a pair one to complete and submit the application, and then promptly forgot about it as our attention turned to more pressing matters.

In August 2018 the Citizen Scientist Curriculum Team received an invitation to participate in a teacher leadership summit that would take place in California. Now, coming out of our previous summer experience, the group needed time and a place to get back on the same page and this was a context where we could start to do that. Attending members of the team included Alex, David, Victor, Katherine, Imani, and me—Michael was home awaiting the impending birth of a child. Our team at the summit represented the perspectives of teachers offering a range of varied experiences, a high school student, and a teacher educator.

Of the hundreds of participants divided into project teams at the summit, ours was the only one that included a student member making Victor, as he describes, "an outlier in the whole

event." Inviting Victor to join the Citizen Scientist Curriculum Team—including participating in the teacher leadership summit—seemed a natural step in the team's evolution. Sitting in a room filled with teams of educators, it became apparent that this seemingly unremarkable decision was different. Since the inception of the NYC Detectives, I had been collaborating with people who were attempting to expand and shift decision making and design of learning to more fully involve student voice. Students had defined contexts for their own learning, they had acted as co-teachers in teacher preparation coursework, they had played a role in the development of curriculum in the previous year's Citizen Scientist cycle. These were all acts of leadership that were happening alongside learning. They were also moments when the permeability of the line between teacher and learner became especially apparent. Victor's participation in this event was another step along this trajectory.

In a large hotel ballroom, the Citizen Scientist Curriculum Team worked alongside other groups of educators—designing their own projects—to develop steps in an attempt to move the aims of Citizen Scientist forward. This work focused on a specific problem of practice: *Students do not have authentic opportunities to practice scientific skills at a rigorous level, nor the structural, academic, social/emotional, or curricular support to excel when they are in these spaces*. Our team interrogated this problem, eventually identifying a theory of action that we could use to guide our work: *If we provide intentionally structured, inquiry-based opportunities to ELLs and students with IEPs, in authentic scientific settings, then students development of academic, social, and emotional skills will increase more than they would in the traditional classroom.* These central ideas offered a rallying point for the group—we may not fully agree on *how* we would achieve our aims, but we *did* share a common starting point. Our hope was to use this context to be reflect on our collaborative efforts and clarify our vision for their purpose.

Following the development of our logic model, the culminating task of the teacher leadership summit was to practice pitching our work to peers and critical friends in the room. Participating with our team in this process incorporated an aspect of audience into our learning and encouraged us to ask ourselves about the stories we want to tell others about the work we were doing. These two days acted as an opportunity for the team to see the work we were doing in a new context, one that offered a perspective on a different scale. We were able to listen to the ideas of others and get feedback about our own.

As the teacher leadership summit came to an end, our team left having been offered time to take a step back and look at the evolution of our work. We were in the midst of addressing challenges and gaps that had emerged and that we were still working to understand. Still, the energy of peers, critical friends, and facilitators at the summit had given us renewed enthusiasm in our endeavors. Our time at the summit had offered a context for structured, collaborative evaluation and analysis of our work. From this experience, we began to realize the value of a few days for dedicated work where we could be together and spend time reexamining the purpose of the program, realigning our interests, and critically considering our next steps. Inspired by our participation in the teacher leadership summit, discussion of an intensive retreat where we could experiment with this style of extended planning was sprinkled into our subsequent autumn planning sessions. We had identified a new approach for dedicating time to unpacking curriculum, analyzing student work, and imagining possibilities for ourselves as the Citizen Scientist Curriculum Team and the project we were working to implement.

The team's efforts to both plan and enact curriculum together led to intentional and explicit discussions that were directed toward the group's dynamic (e.g., How are we working together? What could be better?), identity (e.g., Who are we as a community? Who do we want

to be? What do we want to know and do?), and interactions (e.g., What does it look like and feel like for us to reflect, plan, and problem solve together?). These conversations resulted in collaborative practices that became increasingly refined and complex. Working time became learning time and the socialness of the learning was seen with a greater sense of nuance and understanding. This back-and-forth exchange between the schools and university eventually developed into a process where teachers would leverage their membership in the team to advocate for connecting the school to the Citizen Scientist Curriculum Team.

Zooming in on Torben: "We Can Make Something Possible Here." As a scientist with both lab and field experience, Torben came to teaching with a vision of doing "hands-on science" and viewed this as an "integral piece of science education." At the beginning of the school year Torben stepped into a position as a first-year teacher at Forrester. He was juggling this and completion of an accelerated teacher preparation program that included a brief summer preparatory session and then continued courses during the first years of teaching. Imani was Torben' first co-teacher and early in the year began encouraging him to join the Citizen Scientist Curriculum Team.

Like Imani's own experience, Torben was struggling to acclimate to Forrester. He was quickly finding dissonance between learning in the sciences and *schooling* in the sciences as he attempted to enact instruction in his classroom. Barriers, including access to even basic resources (e.g., microscopes), and constraints established by school leadership were leaving him with a growing sense of frustration.

This was not a matter of being able to support student learning—students *wanted* to learn. In fact, after being told that students had to follow a standard curriculum that limited learning to

a sequence of worksheets and PowerPoint presentations, Torben began offering after school science labs to the students.

> I had a bunch of experiments setup…where I would just come in, give kids materials, we talked about something that we noticed, then I'd say come up with questions about it, we'd pool all those questions together, and then we'd figure out how to answer those questions. I would have…sometimes more kids than could actually fit into the room. We'd have to spill out into the hallway. I had 40 kids at one point, a lot of whom were just there because they wanted to do actual science, doing these experiments, asking these questions.

Torben was excited about teaching science. He was inspiring students to voluntarily show up after school to play around with scientific ideas. He was finding ways to source the materials he needed. But all of the science learning was happening outside of the actual school day. "I was quickly starting to feel as if I was trying to tackle an issue from the…wrong vantage point," He adds, "I was quickly coming to realize…the administration could pretty much tell you like, when they say jump you have to ask how high—even if it doesn't make any sense."

The situation worsened as he found himself in situations such as school leadership telling him he, "just need[ed] to pass this kid" to bolster the school metrics. "Kids aren't numbers, they're people and you can be majorly screwing up somebody's life…and future prospects. And that person trusts you, and that person puts their future partially into your hands," he adds. The situation led Torben to begin feeling "a general malaise" as he worried that, "I'm becoming part of the problem, not the solution." These feelings produced a sense of isolation as he attempted to provide a strong learning environment to his students.

As Torben joined the team, the opportunity to work collaboratively alongside other teachers was critical and stood in contrast to what he was learning about teaching in his school and teacher preparation program. It offered Torben a different space where there was a "feeling of possibility and momentum." He needed to find a space where he could see what the possibilities of collaborative learning could look like and feel like. He was now working in, "this

really amazing sandbox," where he could enhance his own professional learning through an iterative and collaborative process of design and experimentation.

In the space, we were engaged in learning that required us to share ideas, coordinate our thinking and movements, and pay attention to one another. For him, this kind of work was "very, very, very exciting because all I could think about was, 'alright, we're going to actually do something that we're *supposed* to be doing as teachers.'" For Torben, this kind of teacher learning was important as it offered a sense of hope in what learning can be, "It gave me hope. *They* gave me hope. And it made me feel like there are people who care."

Torben recognized the work of Citizen Scientist as the work that, "we're *supposed* to be doing as teachers." One benefit of being part of an *in between space* that offers room for teachers to learn and create is it can act as a context for giving hope as teachers take time to figure out the *how* that aligns with the *why* of teaching and learning. For Torben, it had the effect of "eclipsing my former sense of despair" that was coming from his sense of helplessness as he pushed against the structures at Forrester that resulted in a harmful version of schooling and stood counter to Torben' beliefs about student ability and interest in learning. It provided a new set of evidence of what it can look like for students, *including* students from Forrester, to come together in a different context and engage in scientific inquiry.

At the same time, what are the ramifications of *informally* participating in one space that aligns with your vision of what is "supposed" to happen and *formally* finding yourself in another space that represents the opposite? How does the work of an intergenerational teacher education community sustain teachers such as Torben who are spending the school year teaching in such a challenging context? What can a community situated in an in between space do besides being

encouraging? These were important questions to consider as the year progressed and both Torben and Imani came to each meeting with growing frustration of the situation.

Zooming Out on the Curriculum Team: Expanding Our Approach to Planning. One outcome of attending the teacher leadership summit was an expanded sense of new planning and learning structures that could benefit the Citizen Scientist Curriculum Team. In addition to typical meetings, team retreats, that included intentional moments for building rapport, and site visits, that prompted imaginative thinking for designing rich, hands-on learning with students, became elements of the planning process. Team retreats and site visits were integral to our own learning as we immersed ourselves in a new cycle of planning and underscored principles of intensive collaboration that were already established in a preliminary form. These relational components fostered a shared mindset where we worked to more ambitiously expand our ideas while generating increased experimentation and shared risk taking among the group. In these settings we also established tendencies toward testing instructional strategies first on ourselves and then with pre-service teachers and students.

In a meeting in January 2019 Alex, David, Victor, Katherine, Imani and I met to finalize plans and preparations for our upcoming (and first) Citizen Scientist Retreat. Some of this work was logistical, including making decisions about the retreat agenda (i.e., Saturday: (re)Orientation and Reflective Analysis, Sunday AM: Performance Task, Sunday PM: Build Benchmarks, Monday AM: Parking Lot Day), creating a packing list (from chart paper and pens to marshmallow skewers and thank you notes), and confirming reservations for rental cars and the retreat space. The remainder of the meeting was reflective as we took a step back and twice asked ourselves, “Why citizen scientist?” and, “What’s the purpose?” Our first exploration of these two questions focused on the high school students who participated in Citizen Scientist in

July. What was our vision for their experience and to what extent what that vision shared between members of the group? In a second examination of the same questions, we turned our gaze toward experiences of the teachers—members of our team and pre-service teachers who supported instruction during the summer. What were the opportunities for our own learning that could exist in this space and how were we being intentional about practicing those? Table 4.3 outlines student and teacher facing responses that came from this reflection.

These notes offer a window into a reassessment of the team's own aims in looking ahead to the experiences of the coming year. They illustrate intersections between experience and skill (e.g., meeting kids across the city vs. practice academic language or kids engaging in real life science vs. reason to write, read, learn) that the group were working to design as they considered how to embed academic literacy and language into locally situated contexts of science and activism. The notes also illustrate a clear sense of unity in members' dedication to make learning experiences relevant and fun in ways that push beyond classroom practice. In establishing these

Table 4.2 What's the Purpose? Why Citizen Scientist?

Student	Teacher
Kids engaging in real life science	Reimagining educational spaces
Community/academic community where it's cool+fun to do science stuff	Showing what facilitates language dev but also what lang. Dev. looks like + how successful L2 use can be
Exposure to authentic audience + authentic purpose for science and different forms of activism	Creating learning opportunity for student to demonstrate mastery in modalities that address their lived experience preferred learning styles for expression
Opportunity to see role in activism to be part of it	Demonstrating + graphing w PBL
Academic skill level- bridges gap b/t skills and why we teach them	Demonstrating unpacking and enacting the curriculum (and making sense of)
Opportunities to practice academic language in a meaningful way- a purpose	Demonstrating team teaching, and messiness + imperfection of teaching
Immersion focusing on one thing w/o needing to focus on all other classes---> flows	Modeling reflection of teaching Idea- fish bowl of team reflection
	Think aloud to get inside our brains
Flow provides opportunities for developing so many other skills	See how units are structured, backward planning

Space for vulnerability	Develop flexibility + make adjustment based on student need
Interdisciplinary opportunities (also for PBL)	To see assessments- what are assessments doing, where they can go, alignment w/ skills students are working to develop. What they can look like.
Real reason to write, read, learn about history + context	See kids (and teachers) engaged + engaging on problem solving + decision making
More intrinsic motivation to show up and be prepared to share	See what teacher/student relationship an look like
Opportunity to meet kids from across the city to see what's possible + build	Thinking about how to enact authentic student experience (see other chart)
Community through collaboration that is healthy	Developing content knowledge that will allow them to fully engage in the curriculum + understand ways can be scaffolded to develop literacy
STEAM—what we say it should be vs what it is in classroom	
Sustained focus	

Note: Both student and teacher lists were recreated in this table capture the notes taken on chart paper while the Citizen Scientist Curriculum Team was in dialogue.

factors and examining aspects of the program that had not gone as expected in the previous year, the group was working toward identifying points of possibility that could be reexamined for the coming iteration.

The reflections generated by the team regarding teacher learning illustrates a process of defining and redefining within the Citizen Scientist Curriculum Team space. In doing this, the team examined the benefits of our own participation and membership in the space while considering the possibilities of what other (pre-service/in-service) teachers might also gain through participation. In these notes we see elements geared toward learning of the team (e.g., reimagining educational spaces) while others were directed toward the learning of pre-service teachers and others who had similar professional interests and might consider joining the team (e.g., "demonstrating team teaching, and [the] messiness + imperfection of teaching") These notes maintain consistency in the articulated vision of what we were trying to accomplish, fore-fronted our aim of using ideas to push against boundaries of teaching and learning, and accounted for efforts to figure what it looks like to *actually do* the things we imagined. The

group was building onto an evolving set of shared values that were widening to increase access that people had to it. Reflections of the day were grounded in the instructional experiments of previous years and, when looking across responses, indicate exploration of intersecting values that might sometimes be framed as binary: pedagogical vulnerability alongside confidence; instructional imperfection alongside ambition, team unity alongside flexibility, and reflective criticality alongside creativity. Most of the ideas shared in this session were incomplete. Many were associated with questions—especially in reference to practicality. Yet, we were creating the groundwork for making decisions about how we would embed these elements into our practice.

January Retreat. The first Citizen Scientist Curriculum Team Retreat happened over a long weekend in January. Alex, Torben, David, Michael, Victor, Katherine, Imani, and I were all present at the retreat. For Torben, the retreat represented his first time meeting the majority of the team. Setting aside a three-day period for dedicated reflection and visioning offered the Citizen Scientist Curriculum Team time and space to grapple with ideas in a new way—it offered a moment when we could pause and sit with the ideas we were forming. The retreat offered dedicated time where our attentions were not divided to the many, varied tasks that fill a teacher's life. During this time, we could slow down enough to really concentrate on thinking through student and teacher learning while also considering the effectiveness of our own team and the health of the dynamic within the group. Spending this dedicated time together also reinforced habits of communication that were used during summer programming as each day's events would be followed by what Michael describes as, "a discussion about what went on that day, what we can do better and it's just very open kind of discussion." Establishing this dynamic required that the group work together and spend a bit of "down time" with each other. In describing the overall activities of the retreat, Michael describes:

> I think that we've built a sense of community….That's one of the cores of what people want to be part of is a sense of community. So, we've broken bread together discussing ideas, had disagreements and worked them out, and then done other things together that were community building that weren't necessarily teaching. Like we spent a good portion of the time planning and everything, but we also spent a good portion of the time playing board games and just talking to each other. So, we've built a family in a sense.

The process of building community was necessary and central to our work. As we spent time together and built relationships, we were reinforcing a foundation that allowed us to grapple with difficult ideas that sometime included elements of conflict and continue to nurture a sense of shared purpose that cushioned our momentum in moments when external forces may have otherwise derailed our endeavors. The productiveness of the team was tempered by moments of breaking bread, playing games, and talking. These activities also contributed to the trust and growth of the team as we generated a sense of camaraderie among members that resulted in the environment feeling, "like working with your friends." With a general appreciation and friendship between all and an understanding of the vision that we shared, we could more easily with grapple our differences in ways that led to creative compromise that sometimes had the effect of growing into outcomes that were more than any one member of the group imagined.

> The Citizen Scientist Curriculum Team arrived at our retreat destination on Saturday afternoon and initiated our efforts with a review of the previous year's student work. In the process of building the curriculum, we had started to intentionally align our work with existing state learning standards. This did not change the vision of the curriculum but it had given us language we needed to justify our work as we discussed it with school leaders. Now we looked through student artifacts, searching for evidence of how student learning aligned to standards.

Table 4.3 Collaborative Analysis of Student Work

Example Curriculum-Aligned Standard	Example Assessment Evidence

ELA Writing Standard: Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence	Talks about the increase in CFUs of Enterococcus from sewage, which leads to unsafe water conditions Uses data from surveys to note how much people care about the environment His project was analysis of data, his own and data from previous years. He used his data to support claims
ELA-Literacy in Science and Technical Subjects Standard: Follow precisely a complex multistep procedure when carrying our experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text	Shows steps experiments of first macro invert collection and chemical tests. Then shows data collection on tables. Shows what she finds during trash analysis. He fully described the steps he and his partners took to conduct the chemical analysis tests. He followed these steps to obtain the data. Described the process of water testing
Earth Science-Biogeology Standard: Living organisms alter earth's surface and influence feedback systems (if there is a problem, how is it impacting the community?) *How do living organisms alter Earth's processes and structures? The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.*	He explained in detail how human activities alter Earth's processes (the complex NYC watershed system). He also made simple claims about how we might make changes that would prevent negative effect. Also talks about his home country and the effect the farmers had on a waterfall and watershed. See the closing argument of Alex's letter: The reason why I want there to be a change is because these pipelines are all carrying dirty water into the rivers and other places where we live and can harm people and animals. There are different ways that these problems can be treated using new technology since the current system has outdated technology. I would love to discuss different ways that this issue can be solved. I look forward to your answer. Identifies human activities that negatively impact our environment

Note: Artifact illustrating the results of the collaborative analysis of student work that the Citizen Scientist Curriculum Team enacted during the January Retreat.

Table 4.3 offers an example of standards and assessment evidence generated at this time. This *process* of deep analysis, grounded in detailed descriptions of students' work and aligned with artifacts that connected to specific standards would act as a foundation for the rest of the retreat. The visioning that happened in our preparatory meeting, anchored the discussion and acted as a reminder that, as Alex describes, "we all—kind of right from the get—philosophically thought the same thing about education, about moving students forward, about changing traditional instruction of providing different learning opportunities for students." Our next

conversations were grounded in our recognition that our varying ideas stemmed from this common place. “We all trusted that we all wanted the same thing” Imani adds, speaking of that general philosophy of teaching and learning that the group rallied around. That “sense of trust” was crucial as we began to delve into the nuance of that big idea. We agreed on *what* we were trying to accomplish, but there was much more complexity the *how* we would get there. We all cared about the learning that was happening and were all passionate about developing experiences that felt exciting and worthwhile to students. David remembers:

It kind of became clear…the science teachers are focused more on the science and the data and the…hard science…which was beautiful to support on an ENL level, or just thinking about how can we teach the vocabulary in a way that's going to be more hands on—in a very experiential education type of way. But I think the parts where it felt like it was lacking for me were more…how much time and energy are we putting into learning those hard science terms and those key understandings versus iterating on our project. Incorporating what you've learned, being able to manipulate and change your own… learning moves based on what you've learned about yourself as a learner through the program. It’s not what I was hoping for. Like, we will learn about ourselves through the science, but I think what it ended up becoming at times was we're going to just learn about the science and if we learn about ourselves along the way great but otherwise, we're prioritizing the science.

For David, the science elements of Citizen Scientist played out in ways that were different from others in the group. He had a specific vision of “learn[ing] about ourselves through the science” that didn’t always align with other ideas offered. Meanwhile, for both Michael and Torben, their love for science had first developed from childhood experiences wandering around in nature, “playing with science” (Michael) and, “incessant questioning,

regardless of the setting" (Torben). Both of these team members *had* learned about themselves by being immersed in science—this was part of what they wanted to share with students. Science did not play a similar role in David's experience, and instead he felt a passion for finding "intersection[s] of project-based learning and culturally responsive teaching," that *could* exist in a science setting but for him, this was not a central factor. This conceptual difference was part of the tension we were working through. Michael offers an additional layer to the dilemma:

> We were…going deeper in the science….[T]he other aspect was whether it's solution based or not. And so, I know David and I would butt heads on that—in a friendly way….[W]e butted heads on that where there's all these things we could analyze—go farther and he's like, "No, but it's all pointless unless you get solutions to these issues."

This was a tension that included elements grounded in beliefs about approach and scope of student learning and was connected to conceptions of the cycle of learning being experienced. On one hand, some members of the group were focused on a cycle of data collection, analysis, and synthesis. Alone, these elements of a research cycle are complex and teach important processes of asking questions, working through challenges, solving problems, intensive collaboration, and (in a three-week period) *rarely lead to solutions*. On the other hand, other members of the group were focused on a cycle that embedded elements of human-centered design, defining a problem, creative problem solving, prototyping, and testing (Banerjee, & Gibbs, 2016). These elements of a design thinking cycle are also complex and teach important processes of asking questions, working through challenges, solving problems, intensive collaboration, and *are geared toward finding solutions*. Both cycles are designed to emphasize sophisticated forms of learning and have the potential for deep student engagement. This was not a matter of figuring out who was right, but instead was about making a choice between two good options, each that aligned differently with the experiences and beliefs of members of the team.

Adding another layer of complexity to this dilemma, as a person thinking about supporting new English learners in this context Katherine's perspective of the scope of the curriculum and how much could be done well in three weeks was grounded in thinking about supporting deep learning that attended to the language needs of students:

> One of the big reasons we wanted them to be able to do [Citizen Scientist] is to see themselves as enactors of change….[W]e even have that in some of our [curriculum]—we want them to get there. But three weeks, we thought wasn't quite enough time to go through that data analysis and get to the point where we can actually come up with solutions that are meaningful.

This sense of how much can happen in three weeks informed decisions for creating a curriculum that could align with the interests and needs of a diverse range of learners while also ensuring that the experience accounted for realistic rates for cycles of research and design thinking in professional (e.g., scientific or design) settings *and* student learning.

As a person who did not have the background experience of the previous year, Torben brought a new perspective to the conversation. He remembers a specific moment during the retreat:

> I think sometimes I tend to get kind of lost in the sauce….[With] the science stuff…I can keep going. And I'm like, "oh boy! like, this is great!"….But I just remember one point, getting a sense that Imani was getting frustrated with me….When we spent all that time going over how to divide up the river—loved it! I was very aware, not during that, but after the fact, that I think that it annoyed some people because we spent…it felt like 10 minutes to me, but might have been an hour or two debating the proper way to statistically make sure…it is a rigorous scientific study.

This layered dilemma where we grappled with curricular priorities, instructional approaches, our understanding of science, and beliefs about student support was one where careful listening to the ideas that each person had to offer was key. Time was a vital component in this circumstance as it made space where we could "sit there, stay with each other, talk stuff through in a neutral, positive environment," (Torben). This feature of the retreat is one had been missing in meetings

that, while long, did not include an option for talking, pausing, and coming back to an idea in a sustained way.

Pausing the conversation and regrouping was key in making a space to effectively interrogate these ideas. Imani explains, “we just went to dinner. And then we all just ate….We weren't arguing or anything. And then we came back and kind of figured it out…..[S]ometimes it takes time, but sometimes it also takes a shift.” The ability to set arguments aside and “shift” to eat together at instances of tension offered “a moment to pause and step back from work and talk about other things which I think continued to fuel our personal/professional relationships,” (Imani). These elements of pausing for activities such as eating together came from and led to team relationships that were growing in strength. These actions could fuel the work, even in moments of conflict because, “we…had the same goals and initiative of providing this opportunity to students to enjoy science” (Victor). Even in tense moments, this common ground offered a soft landing place built on that foundational feeling of trust. Alex adds:

> There was so much trust in the group that—I have to be honest, like, if I didn't agree 100% I still trusted that if we went in that direction that I didn't agree with that it was still going to turn out okay. It just maybe didn't hit the area or the direction that I thought would be best. But there was so much trust in hearing something that was different than what I was thinking. And I think it was…because we put ourselves in a space where we weren't just going to have a disagreement and then not see each other for a couple of weeks until our next session…. We were going to have dinner together, right, we were going to meet the next day, we were going to get up the next morning, and we were going to revisit the conversation. And you know, not to say we were going to make progress, but…we knew where each other's heads were at.

A key aspect of the trust that Alex describes was an ability of every member of the team to set aside preconceived notions of the end result of our work and instead offer up full effort while be open to change. This mindset was a form of reciprocity within the team as we each assumed value in others’ contributions while also being fully active in making our own. The outcome of these efforts was a result that was representative of not just one individual but instead the group

as a whole. By "push[ing] in these different directions, we came up with something that was—had a little bit of everything of what we wanted," (Torben) and, "we ended up covering more ground in terms of different possibilities and…went farther along in providing…different challenges that would come up for them…by our arguing in a positive way" (Michael). Engaging in an approach to collaboration that makes space for that push and pull requires that those who are part of the process be willing to give up the notion of *my idea* and instead remain open to the possibility of what *we can create*. This process requires a level of vulnerability where each member trades sole ownership of ideas for a shared creation that is not owned or created by any one person, instead replacing this with a complex representation of the group. In the end, our creation did not include all the answers to our questions. In some ways, we had more questions than before, but we also had a clear path for moving ahead—one where each member of the group took on shared authorship of what the space would be and the potential opportunities that came into it.

These complex conversations that included elements of conflict pushed our thinking exponentially further than if we had all just agreed on the first ideas shared by members of the group. For our intergenerational teacher education community, some of the greatest sources of conflict were rooted in differences in what it looked like to create a space for fostering open curious learning for students—a space situated in science-based real-world dilemmas. "Science is slow," a teacher once said to me. Environmental solutions are typically complex and take years of data collection, analysis, and intervention for sustainable change to happen. Three weeks of work in the summer offered only a glimpse of the full-time work of environmental scientists. This meant that no matter the outcome, students weren't going to see big (or any) change as a result of their efforts. So, how did we teach them that their actions mattered? How did we show

that their efforts contributed to countless others that *could* lead to change? If they couldn't see the change they were contributing to, would they even care about this work? These dilemmas are where the conflict of the group centered—in the middle of questions that had no easy answers. These are questions that we needed to spend time grappling with, and it was important for members of the community to have varying opinions about what that meant for student learning *and to be bold enough to voice them.*

In the course of this study, this dilemma was never fully resolved within the group. It was a conversation that came up on a regular basis and served to support the continued growth and development of the group. However, because this was a sustained professional learning experience, members of the group had the ability to fold this dilemma into the discourse of the community and use it as an element of learning through conversation (Curry, 2008). This is an element of learning that is often missing in professional learning models that offer only "fragmented, 'episodic and piecemeal'" (Boyd, & Glazier, 2017, p. 131) forms of teacher conversation. Furthermore, the opportunity to *extend* the conversation rather than *resolve* it meant that we were able to consider and apply the perspectives of each members of the group in multiple contexts. We didn't just choose one approach to the curriculum but instead over and over again considered the balance between perspectives and measured them against the matter at hand. At times, the result leaned more toward scientifically-focused opportunities for data collection and at others toward connecting with local community members to discuss potential solutions of problems being experience in the local environment. At times, this back and forth did play out as tension, but also created an opportunity for the outcome to sometimes be greater than the sum of its parts.

Zooming In on Marisol: Finding Ways for "Students to Create a Connection with

Nature." As the Citizen Scientist Curriculum Team sought to invite new members, we were primarily focused on finding people with specialized knowledge in the sciences that extended beyond typical classroom instruction. Torben and another science teacher, Marisol, came up as options because other members of the team—Katherine and Imani—had noticed those passions. These invitations came following team conversations about who we knew who might find interest in being part of the space and who might make strong contributions.

In her fourth-year, Marisol joined the staff at Riverview as the Living Environment and AP Environmental Science teacher. Katherine approached her early in the school year to talk about Citizen Scientist. Marisol expressed interest but also needed a bit of time to acclimate to her classroom teaching responsibilities so waited until late in the following spring to begin to attend meetings. In considering her decision to join the team, Marisol felt that participating, "ended up being a really good fit" because of her previous experience as an outdoor environmental educator, a role that, "is really my passion." Marisol explains, "when you grow up in an urban area…you don't have that immediate connection [to nature]." Her vision for teaching and learning was grounded in finding ways for, "students to create a connection with nature."

Initially, Marisol planned to, "get my master's and get a little bit of experience in the classroom and then go back to the informal outdoor education setting." This plan highlights Marisol's initial assumptions about the kind of learning appropriate in school contexts which were informed by her own school and teacher preparation experiences that reinforced dividing lines between classroom and outdoor science learning. Joining the Citizen Scientist Curriculum Team led Marisol to, "realize the potential that I could do both" as she explored intersections between these two worlds that were part of her own experience.

> It's really shown me the possibilities for my students….I consider my lab to be an outdoor space. Especially an urban outdoor space is my niche and where I really want to

> study and learn…and also teach my students…. I see that it is possible to do this outdoor environmental work while being a [classroom] teacher. It allows me to have a bit of both things that I want professionally which is the facilities, health insurance, solid pay—those things are important for me—as well as doing the things that I'm passionate about.

For Marisol, in some ways, classroom teaching was a matter of setting aside some of her educator passions for pragmatic purposes. We often expect educators to make altruistic, almost heroic, decisions as they engage in the profession without accounting for their need for economic stability that is necessary to do that work. We look for those *I want to make a positive impact on the world* justifications for being an educator and don't honor an equally important component of meeting basic needs. As part of the team, Marisol was exploring a newly discovered opportunity for re-balancing intersections between her desire to have "a really stable career" with a method for "developing my passion which was working outdoors with students and figure[ing] out ways to integrate more into my school year." This process of learning informed the development of a new set of understandings about school-based teaching as she discovered ways to realize her vision for learning in her role as a classroom teacher.

As a person teaching classroom content that directly intersected with Citizen Scientist, Marisol was able to make concrete connections between our work and potential instructional applications for her own classroom. The opportunity to work with teachers who had a range of experiences meant that Marisol had access to fresh perspectives in teaching and learning that could inform new ideas about her practice. This acted as "a professional development for myself" as she spent time "learn[ing] their way that they develop curriculum [and] deliver content—that's really helpful." Marisol was coming to a space where a version of teacher and student learning that aligned with her vision was happening. She found herself gaining insight into other teachers' instructional approaches ultimately informing her own sense of possibility. This kind of professional learning was situated in doing work together, side-by-side.

As a science teacher, participating on the Citizen Scientist Curriculum Team also resulted in access to experiences, networks, and resources that enhanced her understanding and approach to science instruction in her classroom. This was informed by distinct aspects of our curriculum design and was enhanced as she made connections with partnering organizations and then returned to those for additional professional learning. She was making content, connecting with organizations, and seeing new approaches to instruction that were informing how she thought about teaching her own students.

Zooming Out on the Curriculum Team: Turning Points in Spring Planning. Many features of the Citizen Scientist space were malleable with new decisions about purpose, process, and participation being defined and redefined through increasingly communal orientations prompted by our shared, on-going experience. This was true not just for the activities of the curriculum team, but also for plans related to the Citizen Scientist curriculum.

The overarching narrative of the 2019 Citizen Scientist curriculum was initially planned to explore how rivers change from the source to the mouth, especially because of human impact. We would collect macroinvertebrates and complete a series of water quality tests at multiple sites to assess the river's health along its length. The curriculum was planned to be implemented in cycles at four locations along the only freshwater river in the city—from the river's source to its mouth. This offered an opportunity for students to engage in and become increasingly familiar with repeated data collection processes while asking progressively complex questions about what the data was saying. For example, in the first data collection cycle as students acclimated to Citizen Scientist, they would ask basic *what* questions: "What do I observe? What am I curious about? What did I do? What is a(n) [x]?" In subsequent cycles, students would add *how, why,* and *comparing* questions. By the fourth cycle they would work to apply their growing understanding

of ecosystems as they asked *what if* questions: “what if we reversed the flow of the river? What if this neighborhood were planned differently? What if you removed [x] from the ecosystem?” In preparation for this revised version of the curriculum we visited new sites, held extensive team planning meetings, and developed new instructional materials that aligned with this approach.

We were seeking to push back against our preconceived notions of instructional limits which informed decision making within the team context. Each member of the team came with both resources and dilemmas that were informed by our various institutions. For example, school leaders from Riverview and Oceanside were especially receptive to brainstorming ways for the Citizen Scientist experience to be integrated into summer school coursework and for it to be credit-bearing. This would especially serve students who had failed a course in the previous school year. In keeping with school requirements, we modified the written curriculum document to explicitly show alignment with state standards and “an end product that [demonstrated] certain types of skills” (Katherine). This work resulted in Citizen Scientist being offered for one or two English or science credits at both Riverview and Oceanside. While Forrester was less supportive of this idea, working through this process with school leaders from Riverview and Oceanside established precedent that teachers from Forrester were then able to use to negotiate for the program to be offered as credit-bearing for them as well. As a general practice, we began to use precedent emerging from solutions established in one school to inform our work across schools: for smoothing the permission process for students to enter the water to collect data, to incorporate summer youth employment opportunities where students were paid as interns to participate in the program, and to experiment with preparatory June field trips where students investigated turtle habitat and went whale watching.

As a teacher educator who was grappling with my own role on the team, I had been spending a lot of time thinking about my own participation in the group and had been working to intentionally step back to make space for others' ideas to be centered. However, because of my positionality—a teacher educator connected to a local college—my role on the team was always slightly different from other members. We all brought recruits who would join in the July programming, but my students were pre-service teachers who played a very different role from the participating high school students. All members of the group played a role in negotiating with schools to offer resources and payments to teachers for July implementation of Citizen Scientist, but I had access to more funding with fewer constraints that offered flexibility as we enacted the program. We all came to sit around the table and contribute our ideas to the curriculum and planning of the program, but the table was located at the college because this was a central location accessible at any time of the week, including weekends, with a range of resources and materials at our fingertips. All of us were part of making this program happen and *none* of us were capable of enacting something to this degree on our own, but when we talked to school leadership about partnering with Citizen Scientist, it is the affiliation with the college—not the other high schools—that we most often emphasized. As a teacher educator, I was able to initiate use of the Citizen Scientist Curriculum Team space in a way that was different from others on the team, but without everyone else, the space was meaningless. This positionality required that I think carefully about my own process of connecting the university to the team.

Transparently interrogating these differences in role and context helped us to leverage the power and resources that came from the university to negotiate in difficult moments. What emerged from multiple cycles of collaborative connections and strategic leveraging of resources—especially those in the university context—was a structure where our

intergenerational teacher education community became centered with each member acting as a bridge between our relative contexts. Organizationally, a central hub was forming with each member representing a spoke that contributed to it. The emergence of the central hub of this structure as not a school *and* not the university is significant and speaks to the nature of this kind of collaborative development that was far more relational than institutional—but that leaned into the access we had because of our connections to the institutional. In this case, as the team developed the space together, pieces of each of the institutions were adopted as they benefitted from the aims of the group.

Affiliating the program with a university also played an important role in achieving our aim for shifting instruction. By tying Citizen Scientist to pre-service teacher summer programming, we created a predictable cycle that included malleable open structures that could be modified based on the ideas we generated in the group. This was happening in a context of reciprocity as students and pre-service teachers benefitted from the growth of the Citizen Scientist Curriculum Team as we engaged in our own process of professional learning. Meanwhile, the presence of the university also meant that members of the team had more negotiating power as we were able to frame some pedagogical moves as being connected to the university. For example, Imani and Torben might be expected to teach using specific materials *in their school* but when enacting the summer program, these expectations were set aside. When school negotiations became difficult, teachers from the school would set up a meeting with school leadership where I would be present. The Citizen Scientist Curriculum Team would often strategize prior to these meetings, discussing who to invite to the meeting (e.g., Do we meet with a supervising Assistant Principal or the Principal or both? Do we start with a meeting with one person and follow-up with a second meeting where more people are involved?), who should start

the conversation (e.g., Would it be the teacher? Would it be me?), and who should say what (e.g., If school leadership has already said no, would it help for me to voice the ask as a way to renegotiate their stance? If we were discussing a new idea, will a teacher best be able to voice how the idea benefits the school?). These interactions with various schools represent a different component of the team's collaborative process. Initial ideas were developed through discussion coming out of our intergenerational teacher education community with strategies then being applied in specific school contexts. In these cases, the discussions coming from the group often had a greater impact on the ultimate outcome than the norms established in the school. The group was able to use our collective power to move school-based policy in sometimes surprising ways.

While this process was certainly important as we worked to create change in schools, it also became a vital element of our experience when our bid for change was unsuccessful. This was true as we engaged in the extensive logistical work necessary for our source to mouth river curriculum. While the mouth of the freshwater river was easily accessible—being located in the neighborhood of one of our partnering schools—the source and two other locations required a short bus ride out of the city. Initially, this detail seemed little more than a matter of reserving a bus and changing the transportation information on permission slips. As we discussed our plans with the leadership in partnering schools, most were enthusiastic and supportive of our ideas. However, members of leadership in one school expressed discomfort in accepting the liability of student participation in an activity happening outside the city limits. Other partnering schools who were part of the same district worked with us to outline clear procedures for gaining the proper permissions establishing precedent for enacting the plan. However, because of the location of data collection sites, members of this final school insisted that district policy prohibited students from participating in the experience. As leadership from the school shared

their reservations, we began an extensive process of negotiation in an attempt to resolve the issue. However, in late June, with the start of the program quickly approaching, we acknowledged this as one challenge we were not going to overcome in the way we envisioned.

As a team, we had already established a priority of creating a summer experience that would be accessible to students attending all our partnering schools. If this was our priority, then we had to acknowledge this current barrier that, despite precedent justifying our stance, was not going to be dismantled and recognize that a drastic shift in our curricular approach was going to be necessary. Alex remembers:

> [W]e had to pivot…and it was like a *drastic* pivot and we're like, "Okay, but you know what? We already know the testing that we're going to do, we already know the things we're going to do, now we're just going to move to a different location, and we have to make it work logistically…and we were able to problem solve within the moment.

Returning members of the team drew on experiences of previous years when we had faced other "drastic pivots." As new members of the team, Victor, Torben, and Marisol also offered helpful insights and asked questions that were informed by their own backgrounds and experiences. We did not have a ready solution but knew we could depend on our shared capacity for problem solving to pull together a new plan that could be accessible and still offer a rich learning opportunity for all. In this context, Marisol listened and, "saw opportunities for adding some of the connections that I knew in outdoor spaces…I had some locations in my back pocket that we could contact." With such a short period of time for establishing new sites, Marisol's familiarity with local environmental alliances was vital. In the spring we had spent our time visiting sites, identifying resources, and making contacts. With such a short timeline we didn't have time to do this for a new site making Marisol's "back pocket" connections especially valuable.

A shift in location also meant that we would need to build in new plans for data collection. The new site, an island surrounded by brackish water, meant that we would not be

able to use our macroinvertebrate data collection method to form conclusions about the river's health. We would continue to use this form of data collection at other sites, but the data would not be comparable. This meant that we needed to add a new data collection method to our curriculum. Here, Marisol also offered new perspectives:

> I also saw opportunity within the curriculum to add information about the physical indicators because I had experience doing that. I was really excited to learn about the things I didn't know too much about because I had never done the program. I was excited to kind of add wherever I saw that there potentially were some gaps.

Once again, an addition of a new team member offered fresh eyes and a new repertoire of expertise leading to strategic solutions that had lasting impact. This resulted in the creation of new (and lasting) partnerships that enabled the necessary maneuvers at hand. As we flexed our capacity for creative problem solving, we were becoming increasingly confident in our ability to move forward with plans and practices that centered our pedagogical priorities while recognizing points that warranted negotiation and compromise.

This season of planning had included several twists and turns as we increased our interactions, revised the curriculum, and negotiated with schools offer new elements in relation to Citizen Scientist. The Citizen Scientist Curriculum Team still functioned as an *informal* professional learning space, but there were *formal* elements that were starting to appear in our connections with schools. These emerged through small steps as we leveraged the ideas of the group and then established processes across multiple schools—some with more support than others. We did not get everything we asked for from every school, but we were able to maintain momentum at moments when we had to go back to the drawing board to rethink our plan. Because of the diverse background experiences of members of our team, we were able to think broadly and access a wide range of resources as we bumped up against barriers and then shifted our plans.

For some teachers, this intensive, collaborative work started to impact their individual teaching as well. For example, Alex's experience of being pushed and pushing back in times when there was disagreement in the group helped him develop comfortability in engaging with colleagues in this way. "I reflected on my time working in Citizen Scientists and my colleagues saying, 'Alex I hear you but, you know, let's think about it this way.' [And realizing], 'Oh, you know what, that does make sense.'" This experience led to a greater sense of possibility that can come from being, "open to listening to others rather than just kind of being stuck in my own frame of mind with my own lens because we're all experts we just wear different hats."

Alex's willingness to listen increased his ability to understand other perspectives and it informed his comfort in sharing his own perspective. "I felt that my confidence as a teacher grew…my fingerprint on the lessons became a lot stronger, it was more visible and my students performed better because of it," Alex explains. As a special education teacher, Alex worked primarily in co-teaching settings sometimes finding it tricky to negotiate those relationships and his position in the classroom. In his work with Citizen Scientist, he had practiced the *how* of enacting collaborative methods for planning which led to a shift in the collaborative methods being used in instruction as well. From his work on the team, he also had the evidence he needed to justify a shift in instruction to better meet the needs of the students in the classroom. Alex explains:

> I started to really use a lot more of the co-teaching models in my classroom because they mirrored a lot of things that we were doing with Citizen Scientist. I…primarily became a station teacher and sometimes did parallel…[or] alternative teaching….I recognized that a lot of the instructional barriers for my students was in large group instruction so the physical makeup of my classroom changed and looked a lot like Citizen Scientist.

A central aspect of the work of teachers focuses on developing strong relationships with students. Too often we forget about the other adults in the room who are experts, who "wear different hats," who also have ideas worth offering. In the Citizen Scientist space, Alex felt that he had

access to a community who would listen and say “I hear you” but would also be willing to grapple with ideas together. Now he was working to extend those same strategies into the school space as he reflected on how he was “listening to others.” In this case, that work resulted in opportunities to shift instruction in ways that mirrored the work of Citizen Scientist *and also* demonstrated the instructional strategies researchers encourage in co-taught classrooms. The work of defining and redefining that was central to the Citizen Scientist Curriculum Team took time, patience, and effort. It was also an imperfect process—not a final destination.

As a member of the team, Alex had gained confidence in asking questions such as, “how can we break apart from this traditional instruction?” and, “why are we doing it this way?” For three years Alex was building an increased sense of *how* to approach both the relational and instructional components necessary for a strong co-planning/teaching dynamic. It was not until the third iteration that he began to actively negotiate for significant instructional shifts in the classroom. Getting to this point took time, but these were shifts that required both Alex and his co-teacher to rethink existing instructional strategies and redevelop new learning materials. These are shifts that required a reconceptualization of what it means to teach as both co-teachers “*became”* station teachers and redefined their overall structure and approach to learning in the classroom. Alex needed time to get to the point where he felt comfortable saying, “Let's come together, let's think of other ideas.” These nudges were starting points for “sometimes difficult conversations” that Alex had spent the last three years practicing and was now trying out in a different context.

In sitting together and discussing ideas as members of our intergenerational teacher education community, often what materialized was a representation of perspectives from multiple (or all) community members. This resulted in authorship of resources, ideas, tools, and

strategies also being communally owned. Similarly, as new ideas were implemented, the group took on the shared burden of risk for either a successful or failing outcome. While still imperfect, this implementation of Citizen Scientist was a realization of the ideas envisioned, brainstormed, and planned by the Citizen Scientist Curriculum Team. It had been a year of growing as we had shared ideas with a wider audience of peers, worked to better understand each other's perspectives, and developed clever pivots to address last minute problems to ensure all interested students from partnering schools would be able to participate.

Implementation: Realizing Our Vision

The 2018-2019 academic school year was a gap year in the residency program cycle of recruitment. This meant that there were no new pre-service teachers to be part of Citizen Scientist. However, members of the previous year's cohort voiced their interest in participating in the summer implementation for another year. We opened this invitation for the soon-to-be-first-year teachers to join with the caveat that they should consider whether their participation would contribute to their need for rest in preparation for the coming school year. In the end, eight members of the cohort decided to participate for the summer. Additionally, a group of interns, considering careers in teaching, planned to join for the summer. Together, these two groups, alongside the Citizen Scientist Curriculum Team, made up the *Citizen Scientist Instructional Team* for this year's iteration of the program.

In enacting the curriculum, we were implementing new and strengthened instructional scaffolds designed to make experiences and content engaging, flexible, and accessible to all as we attempted to mirror the work of environmental scientists. Torben adds, "that first day we did some…serious talking about the science behind what was going on. Students…collected data, then came back and did stuff with those numbers…that often does not make it into a

classroom—data collection and…data discussion." In being introduced to these new forms of scientific inquiry, students were asked to stretch their habits of learning in new ways. The data they were collecting was tangible and could be directly connected back to questions they were asking in discussions. In mirroring the work of a scientist, we extended our approach beyond content and centered considerations of scientific mindset. Students needed to be able to think about *how* and *why* we were doing this work. This included "reflections on how do you feel today about this? How do you want to interact with your peers?" These are elements that, "might not necessarily make it into science class…for all the wrong reasons…But it *is* [important] because that is how you see those children grow from the beginning of Citizen Scientist to the end of Citizen Scientist," Torben continues. In designing the curriculum we were now implementing, the Citizen Scientist Curriculum Team had enacted our own cycles of experimentation and reflection—cycles we were now working through with the students as they collected data, made meaning of it, and talked about and refined their approach to the work. "We were doing stuff that's harder than anything I've taught since then," Imani adds in reflecting on the learning and instruction that happened in that time.

An element of intergeneration-ality that had aided our team in this was the act of working through these processes alongside each other. Teachers on the team were thinking about how these relationships could influence students in their learning as well. Imani explains:

> The kids were—their affective filters were so low, I think because they saw that we were all so close….[A]ll the teachers [would] be hanging out, and I think that they saw how much we enjoyed just being with each other and being in that space. They then were like, "wait, wait what's so fun about this?" And then…they were like, "This is fun!" they started believing it was fun and then they were having fun before they knew it.

Our own habits were anchoring students as they reflected on their learning, asked questions, and engaged in the cycles of the experience. Considering this, Imani adds, "I think the biggest thing that they learned was to be curious and ask questions." Instruction was starting from a point of

student questions—some as simple as, *What lives in this river?* These offered a platform for encouraging exploration that connected to the overarching inquiry. Imani remembers one instance where two students caught a frog:

> We were able to actually explore their interests. They learned more than they would have because they were actually interested. And then we were able to tie what they were interested in with the content of the class. Like, "This frog lives here, that's crazy! Look at all these snails that live here!...Well what would happen if the water was too dirty?" Then they're learning about pollution indicators…algae blooms, those types of things. What a surprise, that's actually a living environment standard.

The content students were learning was directly tied to their personal points of curiosity, like those held by these frog-catching students. These formed as students spent time standing in a river and connected to nature. Notions of pollution and the balance of ecosystems were increasingly relevant as students came to appreciate the implications of their own impact on the environment. Teaching at the intersection between student experience, curriculum, and learning standards is a nuanced and complex endeavor—one deeply informed by observations of student learning.

The data collection schedule and plan we created as we developed last minute pivots for the program offered students opportunities to experience some data collection methods that were now tried and true for the group (i.e., water quality testing, kick netting to collect, categorize, and release macroinvertebrates) while adding other collection strategies (i.e., seining to collect, categorize and release fish) to our repertoire. As students collected data, they were able to consider its implications. They were also introduced to interventions that scientists were implementing in local areas. Our pushes and pulls of the year had resulted in a more robust curricular narrative offering students a wider lens through which to view the complexities of our local ecosystem. As we headed into the final week of Citizen Scientist, the upcoming preparation and presentation of final projects offered a final point of culmination for our work.

The presentations for this iteration of the program would be hosted at the college in a flexible space that was designed to be adaptable based on the needs of the event. Audience members included family members, teachers and school leaders, colleagues from our partnering organizations, a representative from a local councilperson's office, and college students who happened upon the event.

When looking through the Citizen Scientist archive of video footage and photos taken to memorialize the preparation and implementation of the culminating final presentation event of 2019, I still find myself surprised at the level of critical thought and ambition apparent in student projects and the event as a whole. More than once, I've thought, "Wow, I can't believe we actually did that" as I've rifled through photos that depict presenters and audience members mingling in the space.

The images of this event offer a collage of presented scientific findings, descriptions of complex processes in an ecosystem, and recommendations for interventions meant to protect the local environment. The photos depict a large space that has been sectioned off for projects (designed in groups and individually based on preference) to be displayed. The projects of two triads stretch across several feet of the room making space for two large models built to represent a watershed and salt marsh. One pair of students has claimed a corner where a television has been surrounded by large cubes for seating and a few plants meant to provide a comfortable seating area where audience members can talk to the presenters in a setting that has a "homey" feel that the presenters spent a significant amount of time curating. A group of four students have strategically positioned a cluster of tables into a circle with one iPad sitting on each one, they have created a carefully sequenced and interactive exhibit that showcases a series of videos that break down the results of data the group has collected. In one video capturing students as they

make last minute adjustments to their model, one presenter turns to a teacher and, with pride in his voice, says, “I made this!” and then turns back to focus on the task at hand.

At the center of the room sits a stage where students who have opted for a more formal setting will present different aspects of what they have learned through modes such as an animated movie, rap, speech, and demonstration. In footage of one animated short film created by one student to illustrate the eutrophication cycle, members of the audience watch aptly as a bag of fertilizer appears on the screen. Laughs can be heard a few moments later in response to a message that appears on the screen—*I bet your asking yourself what even is this?* The film continues to illustrate the causes of hazardous algae blooms and when it draws to the close, members of the audience energetically clap, whistle, and cheer.

At the end of the evening, students headed home holding one certificate generated by our team and another presented by a member of a local congressperson’s office. The evening had been filled with smiles and cheering. As guests left, I made my way to a backstage area where boxes, spare materials, and other general detritus lay. This juxtaposition—the presentation space, carefully curated for an audience to see, and the backstage area, offering a much more chaotic version of the situation—is illustrative of my own experience as we prepared for this culminating event. As a teacher educator, I had experienced the last two days as a daunting gauntlet of seat-of-your-pants, unpredictable improvisation and problem solving. While students focused on realizing their presentation visions, the Citizen Scientist Instructional Team was attempting to address the creative needs of more than forty students in real time. The results were not always cohesive and sometimes resulted in last second decision making that could be confusing for students and members of the team. This was a problem that I reflected on and grappled with as I packed materials. Now, looking back I wonder if those situations of unpredictability were

something that needed to be solved. Perhaps, instead they represent an opportunity to develop an ability to predict the unpredictability inherent in the moment and embrace it as the embodiment of collaboration.

4.4 Unprecedented Pivots: From Citizen Scientist to Global Citizens

> I was like, "well, how are we going to do this? This doesn't make sense," like, "how am I going to make sure this works?" and I was working with another teacher…and he had some ideas and we started putting some stuff together and then we just made it kind of come together and it worked. So, it worked against my own doubts. So being able to participate within this group has opened up some of my negative thinking or biases in terms of what can and can't be done and it's proven to me—oh no, it can be done, you just have to figure out a way around it or have someone other than maybe yourself that has a different view that can push you a little bit.
>
> — Michael

In the previous section I explored processes of collaboration as I investigated experiences of joining, contributing to, and engaging in the Citizens Scientist Curriculum Team. I offered examples of shared thinking as well as the generative role that the push and pull of disagreement played within the group. In this section I build on those ideas by focusing in on "interwoven exchanges of learning" (Wright, Suchet-Pearson, & Lloyd, 2007, p. 151) that resulted in processes that encouraged a multi-directional flow. These were moments where there were high levels of permeability between boundaries of the roles of teacher and learner. *Uni-directional* learning can be conceived as one where role and experience hierarchies result in firm delineations between the role of the knower and the learner with the flow of learning moving from teacher to student, mentor to mentee, or more experienced to less experienced. This stands in contrast to m*ulti-directional learning* which involves a willingness to engage in learning side-by-side as all members of the community take on interwoven roles of teacher and learner while exploring ideas that often do not have predictable outcomes (Wright, Suchet-Pearson, & Lloyd, 2007).

Teachers need opportunities to experiment with applying their ideas of learning in order to facilitate meaningful opportunities for others. This was work that required sustained practice through multiple iterations of experience for our intergenerational teacher education community. It is an idea that was in its infancy for Katherine and me years before when we first implemented workshops like the 2016 Earth Science Summer School. In this context, we were learning and growing professionally as we thought about how to enhance components of pre-service teacher fieldwork while creating opportunities for them to see the actual implementation of theoretical ideas around pedagogy that were being discussed in their graduate courses. It is an idea that had evolved by 2018 when members of the Citizen Scientist Curriculum Team worked side-by-side with pre-service teachers who were being drawn into the planning and implementation of the July programming—which was acting as an anchor of learning for all. It is an idea that was refined in 2019 as our community expanded and as we built and maintained a sense of trust among the members, listened seriously to the ideas that were being brought to the table, and found ways to incorporate those ideas into what was going to be implemented

Joyful Storytelling

In November 2019, at a moment when no members of the Citizen Scientist Curriculum Team fathomed the drastic changes that were headed our way, we met to reflect on our experience of the previous July and talk about next steps for the program. This conversation included pronounced elements of storytelling as members of the team thought back to the work of the previous summer and then extended them into their current work as they discussed shifts and changes in student learning. For the team, storytelling played an important role in facilitating a process of multi-directional learning, especially at moments when stories extended beyond the Citizen Scientist context offering insight into similarities, differences, and changes that teachers

saw in students as this work stretched into the school year. Here, we see an example of ideas being broadened through a mechanism of storytelling that begins with David:

> I was thinking a lot about the individual students…and their individual experiences. And it was funny, so I was talking to Torben about Jack and I was like, "you know, a lot of adults in our school have never heard his voice. He just doesn't talk at school." Which was so different than here where he was so out-going, and he was presenting and it just really made me think about all of our individual students—what they are able to bring to this space that they might not have been able to bring to other spaces.

This process of sharing small stories is a vital act for teachers as it provides a way to reflect and see students in detail as "it is only by attending to each and every child that schooling can begin its most noble aim of equality in education" (Carini & Hiimley, 2010, p. xi). In this context as members of the group reflect on individual students at different points in time, they begin to form a tapestry that highlights points within the July experience where they noticed high school students showing aspects of themselves that may have previously been hidden as they take academic risks and sink into moments of deep learning. The stories continue, and, in time, they transition into descriptions of recent interactions between teachers and students in the last few months. Marisol offers the first recent memory as she reflects on conversations she's had with Oscar, a student in her school who also participated in the program:

> **MARISOL**: Every time I see Oscar in the hallway when I'm teaching he's like, "Miss, eutrophication!"
>
> *She gestures pointing toward another group member to mimic one of Oscar's well-known gestures. Members of the group laugh in response.*
>
> **MARISOL**: He's like, "Can I take your class? Can I take your class?" Now he's really eager and wants to participate in science, so that's really exciting to see.

The class that Marisol is referring to is A.P. Environmental Science. This report of Oscar's continued enthusiasm and interest to take the class is "exciting" for Marisol, and also for me. This was Oscar's second year participating in Citizen Scientist. When he participated in the previous year, he had only recently moved to the United States and was just starting to learn

English. Remembering back to the origins of the program and our initial goals of creating opportunities for "playing around with science" and mirroring the work that field scientists do, it seems like for Oscar this has fostered increased interest to continue studies in this area. Oscar's excitement over taking A.P. Environmental Science also indicates Oscar's growing confidence in learning in science contexts as his enthusiastic interest likely means he feels as though he has the support and tools to succeed. It also is informing Marisol's thinking as she considers how she might enhance accessibility of A.P. Environmental Science for English learners who may not have previously considered taking the course.

As the conversation continues, Michael, Torben, and Imani offer additional stories tying experiences from Citizen Scientist into their work at school. Michael shares:

> The other day we were doing a lab with starch and glucose going through an artificial cell…—the glucose can get out and the starch can't. Jayden's] like, "oh, that's just like my project that I did over the summer where some of the nutrients would get caught up in the wetland." And I was like, "whoa."

Torben' follows this with another example of a student applying concepts learned in the summer months at school:

> **TORBEN**: Santo stopped by my classroom when the fish tank was first getting set up and went through like a small algae bloom as it was cycling, and Santo was just like, "Mister there's too many nutrients in the water."
>
> *Members of the group laugh*.

Several students who participated in the program are now part of Imani's seventh period class. She adds another example of continued excitement that her students, especially Elianny, continued to show following their participation in the program:

> **IMANI**: Seventh period I have mostly Efrain, Amira, Enmanuel—Elianny, who's not actually in the class but she sits in anyway every day and still asks for her grade.
>
> *Members of the group laugh*

> **IMANI**: She's so great, Elianny. []We were looking at pond water samples and they were super interested in the pond water and then started talking about the summer. And they were like, "Oh, when do we sign up again for the summer?" Elianny wants to work here next year 'cause she saw a lot of students being able to work so they're already so excited about the summer and…trying to sign up already which is really awesome to see how excited they are to spend their summers doing science again.

This conversation indicates seeds of transformation for students as they begin to contextualize their experience and use it as a reference point in their learning. As we discuss their growth, also apparent is evidence of our own transformation as teachers and as a community as we sit around the table and reflect on common moments. While seemingly simple, this brief exchange of stories is profound. The storytelling is joyful. It is noticeably punctuated by a significant amount of laughter. It's a bonding laughter because of the pleasure that comes from seeing students interested, engaged, wanting to learn more about something that is meaningful to them. It's an affirming laughter that seems to emanate from memories of a common experience extending into new contexts in ways that are surprising and pleasing to all.

To work toward mastery of learning, teachers need to be able to deeply explore and reflect on learning processes as they develop a sense of pedagogical decision making that is drawn from their own on-going experiences (Carini & Hiimley, 2010). This aspect of storytelling offers an important element of this process as it helps teachers put the pieces together as they consider the implications of learning coming from our shared work. This orientation requires all to not only be thinking about how to enhance our teaching practice, but also to critically consider the experiences of our *learning practice* and how these inform our work as teachers. This calls for us to consider how we are developing expertise in learning and requires reflection on how past and present personal learning experiences have or have not matched with those we hope to foster in students. Imagine the shift of student experience if we conceptualized teaching as a role that required one to be a *learning specialist: a* person with refined expertise in *doing learning;*

and a person developing a focused capacity to *create meaningful spaces for learning* that anchor student learning; a person whose reflections are punctuated by joyful community storytelling that informs and encourages momentum for enhancing learning for all. Theoretically, this *is* how the role of a teacher is commonly framed in progressive teaching contexts, but how can we expect these complex ideas to match up with enacted pedagogy if supports for developing these practices are not in place?

"COVID Year": Adapting the Space for New Learning Needs

In the spring of 2020 as the world sat in isolation, anxiously watching the spread of COVID-19, I worried that we had hit a barrier too great for Citizen Scientist to withstand. I wondered if we had hit a point where our work had become just another initiative that would join the masses of great ideas that were just not sustainable. Other members of the Citizen Scientist Curriculum Team had similar thoughts. For example, as New York City entered a state of quarantine Michael remembers thinking, "oh, we're done…[Citizen Scientist] is not going to happen over the summer," as he assumed the situation would result in a decision to "wait until next summer" to continue the project. Not unlike the experiences of others, teachers in the residency program network struggled to connect with students and shift their instruction to a virtual space. Members of the Citizen Scientist Curriculum Team shared feelings of overwhelmed frustration by the new and rapidly changing situation. Worried about overloading the plates of everyone in the group we officially paused our Citizen Scientist planning by the end of March to make space for more immediate concerns and hoped—albeit naively—that COVID-19 would blow over in a few weeks. As time passed, I found myself wondering about next steps for the program and, like Michael, started to ask myself and others whether we should just "wait until next summer."

In late April, Katherine and I met to escape our isolation and talk about what we should do. “You and I went for a walk in Central Park,” Katherine describes in one conversation when we are remembering this moment. She continues, “that was a time when that was very scary to do still, so we were both masked as we were both walking.” On this day Katherine and I talked about “how awful” the transition had been to online learning and the struggles that both teachers and students were facing. We talked about Katherine’s own experiences with students during this time, the needs students who had experienced the loss of family members, and a general need for additional social emotional support at a time when many teachers felt more distant than ever from their students. Could the Citizen Scientist community play a role in addressing some of these needs? In reflecting on this conversation, I can’t help but be reminded of other conversations Katherine and I have had over the years, usually in nature, regularly walking as we brainstorm ideas and connect those to learning theories and current research. These are often conversations that exist outside the boundaries of either of our roles. They are conversations that often start with our own needs as teachers and learners and then extend to considerations of how to involve others.

The Citizen Scientist learning space was originally designed as a context for championing hands-on learning opportunities and refining the finer aspects of project-based learning. It was used to foster principles of collaboration and encouraged the development of important elements of scientific literacy. This work had prioritized practices grounded in in-person interactions with an emphasis on physical space—at the river, around a conference table, during retreats, and over shared meals. These are important elements that had served to engage curiosity, create connection, and develop generative spaces for teaching and learning between and among both teachers and students. Now, by necessity, our *method* for community building was shifting, but

the *function* remained the same—to provide space for teachers to think critically about and extend approaches to designing and enacting instruction so they align with the specific and current needs of students; and providing space for students to benefit from the teacher learning that came from that. It takes time and effort to hone the skill sets needed to develop classroom learning communities that successfully attend to the strengths and needs of all, but what happens when those needs and the tools and resources for meeting them shift overnight? In this situation, *student* learning needed to be supported, but so did *teacher* learning. Because of this, with the world around us drastically shifting at break-neck speed, we considered the possibility of presenting an idea of offering some kind of supportive summer experience—something that would provide a space for healing and learning.

This approach—Katherine and me acting as principal initiators, envisioning next steps for the team on our own, and coming to the rest of the group with a potential proposal—had not happened to this extent since the inaugural 2017 summer program. In this unprecedented moment, with teachers scrambling to support the immediate needs of students, stepping outside of the typical communal framework for decision making and instead offering a proposal to the group opened the possibility of doing *something* with students and teachers while accounting for the bandwidth of members of the group and tempering the workload that it would entail.

As we developed our ideas to propose to the Citizen Scientist Curriculum Team in the spring of 2020, Katherine and I considered challenges that teachers were experiencing in shifting instruction to online platforms and, as had been the case in former iterations, thought about how this might still act as a space for experimenting with (a different kind of) instruction. We also recognized the importance of incorporating healing centered practices (Acosta, 2020; Ginwright, 2015) in our instruction and began to read materials to explore how we might apply these ideas.

A colleague had first introduced me to healing centered engagement a few years before and I had in turn started discussing them with Katherine. We could both see potential alignment with the work we had already been doing and began thinking about how to more intentionally adopt principles of this pedagogical method. A key element related to these ideas, *radical healing,* especially caught our interest:

> Radical healing refers to a process that builds the capacity of people to act upon their environment in ways that contribute to well-being for the common good. The process contributes to individual well-being, community health, and broader social justice where people can act on behalf [of] others with hope, joy, and a sense of possibility. (Ginwright, 2016, p. 8)

In Citizen Scientist, we were already attempting to ground our work in ideas of community that centered on building feelings of belonging that came from doing work together and developing a greater sense of familiarity with and stewardship for our local environment—human and natural. The in-person practices of Citizen Scientist were aimed at enhancing both social-emotional and culturally relevant approaches to learning. Healing centered engagement offered a potential framework and language that was helpful as we endeavored to articulate the work we were doing. This was an attempt to extend our thinking and point toward ideas that offered a more holistic and refined articulation of practices we had been exploring while providing a tool we could use to critique and improve our work. In an in-person context, we had a sense of how our practices supported the learning of students, but we were less certain in a virtual space.

For team members, the intent and approach of Citizen Scientist was sometimes quite different from what was experienced in other learning contexts where conversations that focused on social-emotional learning did not always align with their own aims. Torben offers one example, “What I was always told in [my teacher preparation program]…actually felt a little slap-sticky and stereotyping because it was just like, “hey if you have students that, um—like—if—” Torben pauses for a moment, thinking, and then explains further:

> I think there's a fine line between like, "here's what my students are interested in so I'm gonna incorporate this new material," and, "here's what I *think* my students are interested in because they belong to this demographic so I'm going to automatically shoehorn this—the material." That's, I think, a fine line…I never wanted to do the shoehorning because that felt inauthentic and just disrespectful.

Here, Torben was specifically referring to instances while in his teacher preparation program where he was encouraged to employ practices such as connecting all aspects of instruction to elements of popular culture. In the context of these teacher preparation courses, this recommendation was based on a rationale that students of color in urban settings would only engage in learning if these explicit connections were made. As a man of color who attended urban public schools as a student, it was not the use of elements of popular culture in instruction that Torben found problematic, but the "slap-sticky" stereotyping associated with this practice that was based on superficial assumptions of students' interests and capacity for learning. It's not the practice that Torben found problematic but the misappropriation of purpose behind it that he sometimes heard from colleagues and in teacher preparation courses.

As Torben thought about the students with whom he worked, he was thinking about individuals with a range of passions, proclivities, and purposes for learning and it seemed that his strategies for fostering those needed to be more specific. Opportunities for healing needed to be grounded in a sense of "individual well-being, community health, and broader social justice" (Ginwright, 2016, p. 8) which *might* include aspects specific element of popular culture but *might* also include other elements instead or in addition to this one approach. Torben' approach focused on intersections of his own experiences with those of his students that included a process of putting students in the:

> …driver's seat with how we explore the content…because to me it always felt like it was woven into the material. I thought by doing science in a hands-on way and by listening to your students and eliciting their feedback and making them feel like they are—not making them *feel like*, but they *are* the actual scientists in this thing, giving them that position of power.

Torben' main pedagogical concern was less about *method* and more about *positionality* as he considered the dynamic for learning that he believed would most engage students. He was asking questions about power dynamics within the classroom and wondering how these might impact the learning of students with whom he worked. These were also ideas we had been grappling with as a community. We had not necessarily developed the pedagogical approaches or instructional moves necessary to put students *fully* into "the driver's seat", but we were attempting to approximate the creation of learning experiences to shift their "position of power." Despite the jarring shift from physical to virtual instruction, the basic tenets of the program—a space for hands-on learning and experimentation that is attempting to address to the needs of teachers and students including those attuned to power over one's learning—remained consistent.

As a teacher educator, I sometimes found myself reflecting on similar questions relating to power dynamics as I considered my own position in Citizen Scientist Curriculum Team conversations. This was especially true at moments where I stepped forward as an initiator of ideas, especially foundational ideas that represented structural shifts, such as our next steps for the program as we isolated in our homes. Because of this, these instances often required significant reflection and preparation. For me, they were times when I needed to think about team dynamics, my role as a member of the group, and how my words and actions would impact who would be in the "driver's seat" of program planning. In this particular context, my role was often one of facilitator, which required an intentional decision to *step back*—watching interactions between other team members, making space for ideas between the rest of the group to form and develop, asking clarifying questions, and arresting my own tendency to jump in and "solve" a problem. Now I would need to *step forward* in a way that centered my ideas and would likely lead the group down one path or another. It was important to consider the implications of

this as without careful thought this could become an instance of, “coloniz[ing] collaborative efforts with purposes and activities other than” (Hargreaves, 2021, p. 7) those that might be collectively generated as a group. There are elements of uncertainty in a multi-directional learning context for even the facilitators of the space as they may feel ambiguity, uncertainty, and “wonder if the [community members] ever sense my discomfort and read my efforts as disingenuous” (Flood, 2018, p. 22). I often experience these feelings as I attempt to contribute to spaces such as the Citizen Scientist Curriculum Team and I wonder about how others are experiencing my participation.

As was often the case, Katherine acted as my thought partner in preparation our discussion about next steps for Citizen Scientist in the spring of 2020. She helped me consider ways to present this idea that were concrete enough to offer a potential direction while acting only as a foundation to be built upon by all. In situations like this, I would lean on her own teacher educator expertise as we considered and reflected on group dynamics, teacher learning, and structured supports for all members of the group. Preparing for moments such as this was often geared toward helping me think about next steps for extending the space for group learning. Then, when it came time to enact the conversation as a team, Katherine would often prioritize her role as teacher.

In the end, Katherine and I proposed a framework to the team that acted as a foundation for planning and preparation for the summer. In an online setting, the physical action of being able to offer instructional support in the moment would be different—there would be fewer opportunities to look over to another teacher and ask for help—so it was important for those leading the sessions to feel complete ownership over what they were doing. This led to an imagined possibility of the space being one where, “teachers were going to have the opportunity

to develop passion projects" (Katherine) that would become workshops exploring a range of topics. In the initial conception of this structure, we imagined a menu of one-week workshops that would repeat for three weeks. Students would be invited to participate in the workshops that were the most interesting to them during the three weeks with no minimum or maximum enrollment caps on any of the offerings. With this new, virtual conceptualization of the program, not all workshops would necessarily be science-focused requiring a rebrand for our program's name from Citizen Scientist to Global Citizens. Katherine and I drafted a written proposal to present to the team. This acted as a springboard the group to adopt, critique, change, or reject. The proposal began:

> The overarching aim…is to provide students with learning spaces where they can imagine and grow using principles of inquiry-based learning and healing-centered engagement (Ginwright, 2016). The course will integrate opportunities for students to practice and develop important disciplinary literacies and 21st Century Skills that they will need to participate in a global, interconnected community.

Despite the necessary shift to virtual instruction, we were attempting to develop experiences grounded in "inquiry-based" and "community" orientations. These baseline elements centered these efforts while empowering teachers with autonomy to imagine instructional possibilities extending beyond those cobbled together over the last few months during our scramble to adjust to realities of the pandemic.

Our initial meeting with the Citizen Scientist Curriculum Team ended with the decision that we would move ahead with plans for a three-week virtual summer program and would use the proposed framework as a baseline for this endeavor. This decision promptly resulted in a second choice to invite first-year teachers from the residency program to join as members of the Global Citizens Instructional Team. This meant these teachers had an opportunity to join us in playing around with our practice as we grappled with how to best enact learning and teaching in an online environment. This decision also meant that we would be able to offer more workshops

that focused on a greater range of topics, creating smaller spaces that might capture more areas of interest for students while also alleviating the preparatory workload. In the end, teachers grouped into smaller teams of two and three to collaboratively develop a total of eight workshops: Activism, Fight for Your Rights!; Computer Programming; Creative Self-Care; Getting Microbes to Work for You; Home Gardening: Grow Your Own Garden; Managing and Making Money; Solar S'Mores; and Water Quality in NYC.

With the development of workshops underway, my own role would be to provide teachers with as much experimental latitude as they wanted to test the boundaries of virtual instruction and organize pre-service teachers to participate in the endeavor. Teacher teams leaned into this opportunity, planning for learning spaces that would use a variety of interactive media and physical learning materials. This new context presented challenges seen and unseen for everyone as we shifted from an instructional approach that was as physically immersive as possible (putting students in the middle of a river to teach them about ecosystems) to a virtual experience that, in the previous months, had led teachers to share that they felt distant and detached from their students. The team was attempting to design experiences that approximated our aim of offering a space for inquiry—and maybe even healing.

Just as our instruction would pivot from in-person to virtual contexts, so did our planning process leading to changes in the ways we organized ourselves as a team. In previous years, the work of the Citizen Scientist Curriculum Team happened in a shared physical space with members of the group taking part in all aspects of decision making. This year, because of conflicting schedules and increased workloads, participation in meetings most often happened in smaller units. Pair and triad teacher teams met on their own to plan and problem solve for the workshops they were leading. All participating team members joined in a limited number of

inter-team working meetings to report on progress, problem solve, discuss logistical challenges, and consider how work was aligning with our outlined framework. Each working meeting happened as a set, meaning that we had one unified agenda of what we would work on together. However, teachers' limited and conflicting availability meant that multiple sessions of the same meeting happened on different days and at different times so all would have a chance to participate. I attended all inter-team working meeting to act as a consistent source of information, especially about dilemmas emerging between conversations. For example, in one early working meeting session, Alex and Imani shared that their workshop, Computer Programming, would be most effective if they planned it for a full three-weeks. Because this did not fit with our initial intention to develop one-week workshops that would be facilitated three times, Alex and Imani's need prompted new conversations about time and timing that led to an overall scheduling shift (i.e., some workshops were scheduled for two or three weeks to fit the scope of the curriculum while others maintained the one-week length and were repeated three times) for the full Global Citizens program.

Working meetings regularly included conversations where we contended with aspects of enacting principles of teaching and learning in a new context. Experiential learning was a foundational element that had always been an aspect of discussion and experimentation for the group. Now teachers attempted to shift their approaches to an online setting while maintaining that same spirit of exploration they were already working to refine. Teachers wanted students to have an experience of learning that would feel rigorous, interactive, and meaningful—feelings that had generally been missing in the previous months of ad hoc, seat-of-the-pants virtual instruction. This led to conversations about how to incorporate the use of physical materials and instructional opportunities to build, create, and grow central aspects of the virtual learning space.

Similarly, discussions that centered ideas connected to healing centered engagement offered new and more nuanced ideas for supporting students' immediate (during the three-week program) and long-term (as teachers continued to work with students in their schools and subsequent iterations of the program) needs.

As a teacher educator, I was asking myself questions about bandwidth for the group. At a time when everyone was feeling isolated and helpless, members of the team were interested in doing *something* that would be empowering and enriching for students and teachers. I wondered how our space might be used to reinvigorate members of the team, even in these extraordinary circumstances.

Setting Aside Efficiency: Prioritizing Ambitious Learning. Marisol, Michael, Torben and I were all participants in one early working meeting where we discussed basic workshop concepts, made initial logistical decisions, and considered preliminary applications of healing centered engagement in virtual instruction. Marisol represented one half of a planning pair with her partner, Katherine, joining a different working meeting. Torben and Michael were a second planning pair who were collaborating to develop what, in the end, became two workshops. Rather than designing a workshop, my role was to fit contributions together while considering overall logistic needs of each pair to implement the ideas being imagined.

Even in a virtual meeting, some of the informality that came from the familiarity of our in-person work continued to support a community culture of collaboration. This included moments of general conversation at the beginning of the meeting as members of the group offered updates on family, changes in their teaching experiences, and challenges of both teachers and students who were now participating in this online version of school while isolating at home. Shifting to more formal agenda items, we turned toward preliminary reports on the plans that

each teaching team was working to develop. This reporting element was a distinct departure from our typical in-person activities where most of the time was dedicated to working together with little if any work being divided out to be done outside of that context. Now, *teams* of teachers were engaged in collaborative working meetings, but inter-team meetings were used mostly for reporting progress on projects, troubleshooting problems, and expanding ideas being developed in the smaller teams to the wider group. In this inter-team meeting, Marisol was the first to report the progress of her team—a workshop that maintained the Citizen Scientist theme with a focus on studying water quality. She explained:

> [The students will] think about how adding certain things to the water, like different household products, would change the results. And then having students go on a virtual field trip to different sites in New York City or even upstate New York and have them think about what physical factors in those sites would contribute or change the quality of the water there.

The processes Marisol describes are reminiscent of those we had been refining in the in-person version of Citizen Scientist with an emphasis on data collection and analysis, only this time from home. Questions in the curriculum would mirror those from the previous year, (e.g., "what physical factors contribute or change the quality of water?", "Where and when do we see those changes?") while accounting for new contextual factors that were a result of students being confined to their homes. Marisol and Katherine were thinking about how to translate strategies for implementing aspects of data collection and connecting learning to the local context into a virtual setting. The creation of virtual fieldtrips and opportunities for data collection were strategies that were shared in subsequent meetings and adopted by multiple groups. For example, for one virtual fieldtrip, I physically visited a site acting as the eyes and ears of the group while Face Timing with them and being directed to move the camera toward different elements. For other fieldtrips, teachers pre-recorded visits to sites and used these as opportunities for students to connect to what they were learning in the virtual setting. Similarly, students collected data

about water quality using the same kits as we used in the summer, but this time in their homes. In other workshops, they tested questions they had about concepts such as convection and photosynthesis using physical materials to collect data as students participated in online workshop communities. Even though our opportunities for engaging in shared spaces was now different, teachers were still pulling from each other's ideas, borrowing instructional strategies to extend learning experiences, and developing workshop elements that leaned into opportunities for hands-on experience.

As the conversation continued, Marisol shifted from a description of student learning to thoughts about the students who would participate. She added, "I teach an AP Environmental Science class, so I was thinking of having the students that are going to participate…be the students that take part in the [workshop]." Superficially, this focus may seem like a divergence from the aim of Citizen Scientist to create complex, hands-on learning spaces that are accessible to students who typically do not have opportunities to participate in these more intensive science learning contexts. But this is the class that students like Oscar (the student Marisol mentioned just a few months earlier who had been asking to join the class) had started to express interest in taking and Marisol was thinking about how to address their needs and set them up for a positive learning experience. As she thought about possibilities for the summer, Marisol was connecting curriculum reminiscent of Citizen Scientist to upcoming plans for her own class—she was using the space to develop aspects of her teaching approach that she would then be able to incorporate in the coming year in the event of continued virtual instruction. All students across partnering schools would be invited to participate in this workshop, but Marisol's plans were strategically leveraging the time to align with specific questions related to the learning needs of prospective AP Environmental Science students in the upcoming year. While the context for the year was

different, Marisol was continuing to build on learning that had come from our collaborative work of the previous year while experimenting with its implementation in a new setting.

In going through the workshop design process, Michael and Torben took on a different approach that led to the proposal of two distinct workshops. Michael acted as spokesperson for describing the first workshop:

> We're looking at how students can use fermentation to prepare different foods….Many different cultures have used fermentation as storage since there was no refrigeration… and now that's become part of…food that they continue to eat. So, [the students] get to choose to explore a certain culture and then actually make that food.

Michael and Torben had developed a workshop idea that shifted away from the content of previous iterations of Citizen Scientist. They had pulled in new learning objectives and planned to explore a new scientific process (fermentation) with the students. However, structurally the curriculum utilized an iterative framework that brought to mind the cyclical approach of Citizen Scientist. Their imagined possibilities for virtual instruction were ambitious and extended outside the boundaries of their experience as they considered incorporating elements of food and cooking into a virtual setting. As the meeting continued, Michael added:

> [The] challenging part would be sending them the ingredients in a timely…manner, so that it doesn't go bad…so, we'll have some fun logistical challenges.…[W]e're thinking about doing it over two weeks [so] they can also look at…how they can adjust it in the second week and make something by adjusting a variable and looking at how their food would change—or their tastes would change…when they redid their experiment.

Michael and Torben were thinking about the logistics of their ideas but were not being limited by them. Instead, they brought these possibilities to the group, ready to brainstorm how to address some of the foreseen challenges. We may not have been physically sitting around the table, but as we considered possibilities that, in another context, might seem outlandish we were still imagining ambitious options for learning that did not necessarily come with simple solutions. As Michael described the pair's ideas, elements of iteration and the incorporation of

food were especially apparent. In an in-person context, food had become a central humanizing factor of relationship building for the Citizen Scientist Curriculum Team (in our meetings) and with the students (during July programming). Torben and Michael were now experimenting with the addition of this strategy in a virtual space. Similarly, they built in elements of iteration as they considered how students might engage in their own experimentation through cycles of "adjusting a variable" and identifying potential changes.

These familiar principles of practice offered a similar baseline for the second workshop idea of the pair that Torben now described:

> [W]e could basically have students go through a design and iteration process for building solar cookers with the end result…being we all eat collectively on Zoom the food that we cooked….[W]ith my students…and I know for me personally as well there's nothing more powerful than the act of creating something from scratch, because it really does make you feel like, "I can do anything, I made that!...I made this oven and it cooked a s'more and so now I can go do, you know, whatever assignment someone throws at me or whatever obstacle comes down my way." So, it just might be something that might be fun to do…but lots of iteration and math involved.

Pulling from his own experience, Torben was exploring the possibilities of incorporating building and design into virtual instruction. As a team, Torben and Michael were using the space to experiment with aspects of their common vision for finding ways to "explore the content" that focused on "doing science in a hands-on way." Torben was describing an attempt at fostering a virtual space for asking questions, "listening to your students," and ultimately developing ways to put students in a "position of power" as they filled a role where students didn't just "feel like, but they *are* the actual scientists." In this workshop, Torben and Michael were working to layer elements of student decision making, empowerment, and open experimentation into the virtual learning context.

In this new setting, all teachers on the team had spent the last months disappointed in the virtual instruction (including our own) being offered to students. Our immediate need was to

have an opportunity to experiment with strategies for implementing interactive, innovative approaches to virtual learning that extended beyond our existing experience. Because of the flexibility of the space, Global Citizens could be used as a context for this exploration. The proposals of Marisol, Michael, and Torben represent three approaches in this endeavor that centered different aspects of our continued work in a new and less familiar context—the water quality workshop by elevating the content, the fermentation workshop by refining understandings of iteration and inquiry, and the solar s'mores workshop by embedding elements of student decision making and problem solving. Each of these approaches represent an intentional push outside of our instructional comfort zones which, inevitably led to new challenges of *how* to implement these newly envisioned ideas.

Pedagogical Logistics: Bringing Visions of Instruction to Fruition. A key aspect of my own role during this iteration of Citizen Scientist was to provide the support needed to bridge the gap between teachers' instructional visions and the actual implementation of those ideas. This was not about efficient instruction. Instead, it was about paving the way for experimental learning where both students and teachers had access to what they needed to explore new ideas in a virtual setting. In this context, we were not aiming toward scalability or sustainability. Rather, we were attempting to consider how we could implement principles of care and support to the teachers and students who were part of the community right now—who needed a space to experiment, learn, and grow even in "unprecedented times." Because of this, as members of the curriculum team brought up potential challenges for instruction, my tendency was to emphasize vision over logistical practicality. In the meeting with Marisol, Torben, and Michael, this tendency came out in conversations regarding logistics. For example, in a short exchange

between Torben and me we began to consider how availability of resources aligned with the ideas for instruction. Describing the materials for the solar oven workshop, Torben said:

> The most expensive thing that they would need…on the budget is…thermometers, because that way they can actually collect temperature data. I mean, they could—they don't have to—I mean they can pretty much see, like, "Did the cheese melt on my grilled cheese?" or, "Did the marshmallow melt on my s'more?" …[I]t'd be pretty interesting to get like, "with this iteration of design, I'm able to get this much of a temperature raise here."

Torben had envisioned a lesson that embedded opportunities for temperature-based data collection and analysis that were integrated into a design thinking process but he had also considered modifications where students would use *only* observational data (e.g., "Did the cheese melt on my grilled cheese?") for their work. As a teacher working in a school where funds were often not allocated toward instructional supplies, Torben was accustomed to designing curriculum in a setting of scarcity where he needed to think about ways to mitigate the limitations of learning even when missing basic resources. For him, scenarios where he may not have access to supplies as basic as thermometers in his science classroom were not uncommon.

In this scenario, my response to Torben' question about access to thermometers was, "yeah, and I actually have thermometers, so we wouldn't need to buy new ones." Which meant I could simply offer resources that were already in our stock of supplies. However, if we didn't have thermometers, what would our next step be—to opt for a thermometer-less workshop? My response of "yes, and" in this moment is a representation of the power of my role as a member of the team. As a curricular element of pre-service teacher preparation, I had access to a budget that could be used for the various supplies (e.g., water quality kits, thermometers, sour dough starters, and cabbage) that were needed for these workshops. In this setting, the work of the teachers would result in a robust field experience for pre-service teachers (even in a virtual setting) and would also positively impact the learning of teachers and students in schools. This logistical

aspect of the workshops was acting as a mechanism to weave together the learning for the community as a whole.

This situation can sometimes be less a matter of how many dollars are going into schools and more a matter of allocation of budgets. For teachers on the Citizen Scientist team, accessing funding for instructional materials such as cabbage and thermometers tended to be complicated, especially when purchases did not align with the personal priorities of school leaders. This created a gap they would often fill by personally paying for the supplies that most closely impacted the learning of students. Teachers are often accustomed to making do with what is available or supplementing supplies with their own money, but without access to the resources they need, maintaining creative momentum is possible for only so long before their ideas succumb to a scarcity mindset.

As we planned for a virtual iteration of the program, the resources we could (or could not) access would either open avenues for teacher's (pedagogical) and student's (conceptual) experimentation or block pathways of possibility being generated by the group. Having access to a budget alleviated a barrier for leaning into and experimenting with ideas for enhancing virtual instruction. However, even more important was mindset forming as the group engaged in a process of coalition building in identifying and sourcing supplies. In this year, this process included those components of shared brainstorming and many of the physical resources for learning were provided by the residency program. In subsequent years, this mindset evolved further as teachers began to share supplies from their schools and as the residency program loaned supplies from the summer program to teachers during the school year to implement aspects of the curriculums being developed in their various classrooms. This informal process of asset mapping further connected members of the community that the group could use to solve

both individual and collective problems (Lightfoot, McCleary, Lum, 2014) in the summer and during the school year.

As we continued to plan, a second concern of getting supplies to students reemerged. We all knew that somehow, we would find some way to get materials to teachers and students, but we had not come to a solution for how to do that—yet. In the conversation, Marisol identified, "mailing is an option, but maybe having some sort of…drop off place or…pickup site for students." This proposal would work for students who attended schools in their neighborhoods but wouldn't meet the needs of those who commuted long distances. Here was another "yes, and" as I added to Marisol's initial idea:

> **SUZANNE**: Yeah, and…if I have a strong sense of all the materials that are needed, then we can just set up delivery sites where, I mean, especially for Oceanside students they would have to be in a lot of different places…so that kids can pick them up…. Riverview is a lot easier because we probably can just…have *a* delivery site and most students are going to be pretty close to that area…. And then I'm imagining that that's something that we would have to do in preparation for every week for the week-long modules…
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> **MARISOL**: Yeah, I think the pickup sites might be a better option or like doable option for us. Yeah.
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> **MICHAEL**: I think that'll be really helpful with the, the ingredients aspect of the fermentation one because I was thinking it's gonna be a nightmare to try to ship the ingredients for kimchi or whatever to, like, students.
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> **TORBEN**: Especially in this hot weather.

In the end, as we implemented this iteration of the program, we did use the delivery site method that Marisol, Michael, Torben, and I discussed for the first round of supply deliveries. However, in the height of the pandemic, we found that parents were understandably uncomfortable with students leaving their homes to pick up supplies. Because of this, in the subsequent weeks, I delivered materials to each participant's home with the help of an extremely generous friend. This process involved mapping a route that took us to nearly every borough in the city on a weekly (sometimes daily) basis. It also resulted in the unintended outcome of establishing

another point of connection and care with students as each week we would be at their door with a new box of supplies that was prepared just for them.

At one point, a person affiliated with the residency program who learned about this method of materials delivery chided my willingness to spend three-weeks driving from home to home, "You should be spending your time doing other things," and "There has to be a more efficient and easier ways to do this—like using fewer supplies," this person said. One thing that we had learned from Citizen Scientist was that efficiency comes with experience and none of us had any experience running the program in a pandemic. To push our boundaries beyond the borders of our experience we had to be willing to experiment in *inefficient* and *difficult* spaces so that we could later use the knowledge we gleaned to reflect and develop more effective iterations of our ideas. When we put efficiency first, we are forced into corners where the only answer is, "no, that's not possible," when many times it *is* possible, we are just not at a point where it is convenient or sustainable—yet. For Citizen Scientist, this resulted in an ebb and flow of work where some years came with more logistical challenges that are inevitably unpredictable, messy, and did result in more work. However, by iterating through these problems a structure began to form that included logistical processes that did speed up and become more predictable over time as our experience informed our considerations for effectively enacting the logistics supporting the pedagogical decisions of teachers. This method of *pedagogical logistics*, where the logistical details *followed* pedagogy pushed us to solve problems in ways that centered our aim of enhancing learning opportunities. Because working through these structures takes time, a decision to build instruction in this way requires initial, intentional decisions to not let efficiency or logistical ease dictate the limits of pedagogical decisions and therefore student learning.

Implementation: Iterating on Practices of Multi-Directional Learning

> *Do you like plants? Do you want to learn how you can grow them at home? In this short class you will learn exactly that while also exploring how we are part of nature - even in New York City! As we plant gardens in our own homes, we will learn how gardening benefits us, our communities, and our planet. We will explore how our actions impact our environment and how small changes to our daily lives can further help us to protect the Earth. Let's come together and welcome a little green into our homes!*
>
> *Riko and Dan*

This is the description of one one-week workshop, Home Gardening: Grow Your Own Garden, developed by Riko and Dan. The two collaborated with a team of three pre-service teachers and one undergraduate intern to design instruction that would explore how "we are interconnected with our environment" by asking questions such as, "how do my surroundings impact me?", "how does my relationship with my plant affect my overall well-being AND change the way I view how we should interact with the environment?", and "how can I encourage others to enact change in the ways they interact with the environment?" In their design, Dan and Riko hoped that students would walk away from the experience with an understanding that, "we can use observations to help us understand what is going on in our environment and how this impacts us," and "our environment is a reflection of our society."

As they planned for the summer workshop, Riko and Dan drew from their recent experiences shifting from in-person to online instruction as they each wrapped up their first years of teaching. Now, as they prepared to lead a workshop while learning alongside pre-service teachers and students, they referred back to their experiences in the previous two iterations of Citizen Scientist—their first year, as they experienced the program through the lens of pre-service teachers and the second, as newly graduated teachers who were participating with a greater sense of the trajectory of the program. In both of these contexts, they had spent time talking in community about how to address challenges and enhance aspects of learning for

students, pre-service teachers, and teachers. Now, in this less central space, they were presented with a new challenge. Dan remembers:

> So me and Riko kind of brainstormed general ideas of what we wanted for the class. We kind of presented that outline about home gardening to the [pre-service teachers] and then once we had our [workshop] team—we were kind of like, "well, here's what we have so far, what do you guys think?" It was very bare bones of an outline.

Having been a key part of the curriculum design for the 2018 iteration of Citizen Scientist, Riko and Dan approached planning with a collaborative eye. This was reminiscent of the big picture planning for this year as I had presented the group with the "bare bones" outline of what Katherine and I had conceived and then said, "well, here's what we have so far, what do you all think?" Now in the context of their home gardening workshop, Riko and Dan were acting out principles central to the ethos of the program. This included spending time thinking about the learning of pre-service teachers as they generated a space for side-by-side experimentation of learning and teaching with the rest of their workshop team. In this context, they were building parallel capacities of collaboration and curriculum design as both learners in and leaders of the Home Gardening workshop. The development of the workshop included a lot of unknowns and as new teachers both Riko and Dan were still in the process of figuring out basic aspects of their own teaching practice. They had a lot of questions and didn't have many answers but saw other members of their team as resources who could help as they engaged in the process of learning as they planned. Dan continues:

> [The pre-service teachers] were like, "we should do X, Y and Z" and we were like, "that sounds incredible, we're definitely going to do that," and they had very specific ideas about like, "here are the labs that you can do"—like we did one with a bean in a plastic bag the kids could grow in their window, we did a repotting thing, we did a self-care painting project—and a lot of that was the [pre-service teachers] just being like, "well here are things that we could do, what do you think?" and we were like, "we think that's great, let's do it," and then me and Riko kind of met and fleshed that out from there.

As was the case with our inter-team planning sessions, the "yes, and" orientation used by this

workshop team is an illustration of how this norm was implemented on multiple levels. Here, pre-service were teachers playing a significant role in planning up to the point permitted by their time and bandwidth. All members of the group lent their hand in developing details of the workshop and contributing "their own unique life experiences...personalities, their own sets of strengths and areas of growth," Riko adds, that resulted in a sense of shared ownership of the curriculum. Then Dan and Riko filled in the gaps. "We were…like, 'here would be a good order for that, here are some supplemental activities, here's more…information about plants and plant parts and how plants grow….' [T]hen meeting again…walking through the final project, [then] getting more input," (Dan). Like the experience that Riko and Dan had years before, this approach offered a context for scaffolded curriculum development where pre-service teachers participated in a planning process that modeled how curricular ideas are moved from conceptualization to implementation. Here, members of the workshop team simultaneously contributed to and built on each other's ideas. Riko and Dan's willingness to listen to and incorporate the ideas being offered affirmed a sense that all had something to contribute. Their role required that they participate in the space as both teachers and learners. Concurrently, as team leaders they were considering aspects of the community dynamic and facilitating a space where members were working alongside each other as they learned and prepared for experiences for students.

This process also extended into the implementation of the July workshops. In this context, the workshop team would implement the one-week workshop three times (in the first, second, and third week of the program) with three groups of students. From an instructional perspective, this approach was analogous of the iterative cycles that had become a central tool to the Citizen Scientist Curriculum for informing teaching, reflection, and revision. "COVID year

was even more iterative than the regular year" Dan remembers. From their own experience, they anticipated that pre-service teachers may feel, "nervousness because it's the first experience but also there's a lot of excitement because there are so many different opportunities," (Riko) and also saw this as an opportunity where "we were able to go back over and be like, "okay, well what worked? What didn't work?" (Dan). This element of reflection was always an aspect of implementation for the program, but this time, changes being made could be implemented in a reboot of the curriculum in just the following week. This reinforced a process of "bringing in some questions," "fleshing…out" ideas in based on the conversation, and then "actualizing whatever it was that [was] suggested." Here again, as Dan and Riko worked alongside their team to create this learning experience, their actions mirrored those of our previous larger scale Citizen Scientist implementations. The group was developing a workshop that married the *experience* of its members with shared *inexperience* with online learning to create hands-on learning opportunities specifically tailored to a virtual setting as Riko and Dan modeled the practice of, "taking chances and knowing that we aren't always going to know exactly how it turns out" (Riko). As new teachers, Dan and Riko worked alongside members of the group to experiment with pedagogical approaches that reinforced practices to enhance student learning with a recognition that the outcomes of some of their ideas were unknown.

In addition to their work in the Citizen Scientist context, these instructional and pedagogical questions aligned with supports they were receiving professionally through mentorship as new teachers in their schools. In the context of Citizen Scientist, the two were also exploring ideas about how to cultivate collaborative teacher-facing spaces that fostered habits of coordinating thinking, reflecting on practice, and sharing the risk of ambitious teaching as they worked alongside pre-service teachers to conceptualize and lead a newly designed virtual

workshop. Dan and Riko were still doing the actions of side-by-side learning that our team had been using since they were pre-service teachers. Actions that emphasized elements of collaboration, contribution, deliberation, reflection, and risk. Now their scope of consideration was expanding as they were thinking about how they personally enacted these elements and *also* how they might develop opportunities for additional members to participate in them as a team. This is not a role that was structured in an expert-novice orientation where Dan and Riko were being asked to act as *expert teachers* who would deliver all answers about pedagogy and instruction to other members of their team. Rather, this situation offered an opportunity for Dan and Riko to act as *lead learners* as the two worked and learned alongside other members of the group. Riko describes:

> It was exciting but also very challenging at the same time. I'm still in the beginning stages…of thinking about my students and their learning so then adding on like, "okay now think about the [pre-service teachers] as well." I think it's an exciting challenge because I know I've been in their shoes…and these experiences were a large part of why I felt more comfortable coming out of grad school and going into my first year of teaching. So I wanted to…support the current [pre-service teachers] and having that sort of experience as well.

Riko and Dan were practicing sets of parallel (and sometimes overlapping) skills—some specific to teaching and others specific to teacher leadership. This required a bi-focal orientation to the workshopping space as Riko and Dan considered how to support the learning dynamic of the students who would participate in the virtual workshop and the learning and working dynamic of a team of teachers who were acting as collaborative partners in its development. Dan and Riko were thinking about elements related to student learning and student experience (e.g., "seeing what other people do" as curriculum is built and enacted, and "building experience for me and for my…lessons") and they were also thinking about elements of teacher learning and team dynamic (e.g., having the pre-service teachers "take more of the lead" during instruction, and asking pre-service teachers, "Okay, what do you want to get out of this experience? What sorts of

things would you like to practice?"). They were being encouraged to facilitate the growth of a learning space where all members could ask questions, engage in experimentation, and learn about aspects of the learning process together—a space they had been experiencing since they were pre-service teachers.

As the three-week program began, Dan and Riko were both cognizant of their own experiences as they worked with the pre-service teachers to "jump in" and try out the curriculum they had a hand been developing while understanding, even in moments when they might feel "a little stressed" about not having everything fully developed. Riko explains:

> Something that Dan and I were very cognizant about was making sure that you're asking pre-service teachers, "okay, what do you want to get out of this experience? What sorts of things would you like to practice? How would you like us to support you?" The pre-service teachers were very open to sharing their comfortabilities and things that they wanted support with. They were open for trying new experiences even if they weren't sure how it would turn out. They were like, "you know what, I'd like to give it a try, let's see how it goes," and then we can talk about it afterwards.

Just as Riko had found an opportunity for risk taking and experimentation in her first year participating in Citizen Scientist, she was now thinking about how to create the same circumstances for learning with others who were part of the workshop team. She was thinking about how to encourage members of the group to be "open for trying new experiences even if they weren't sure how it would turn out" at the same time as she herself was entering a situation with an unknown outcome. Both she and Dan were willing to put themselves into a situation where the boundaries of instruction were being pushed and in creating a space where others could do this as well. As pre-service teachers, the in-person iteration of Citizen Scientist offered Dan and Riko an opportunity to be exposed to learning in a new context—the river—that came with a specialized set of challenges and rewards. Here the pair were working to create similar opportunities with pre-service teachers, only in another new setting—the virtual, yet hands-on, classroom.

Epilogue: Reflecting on Change Over Time

In the introduction of my dissertation I described a moment of culminating reflection that happened on a July morning as Michael and Alex stood talking while looking out toward groups of students who prepared for the culminating day of implementation for the 2022 Citizen Scientist cycle. Rather than representing an *ending* for the Citizen Scientist Curriculum Team, this moment illustrates an element of stepping back to reflect on ways the collaborative contributions of the team resulted in a transformation of teacher and student learning *to date.* This was a moment when Michael and Alex were thinking across the multiple years of their work and were experiencing an opportunity of "really seeing where it's gone." Michael and Alex were watching the enactment of pedagogical practices we had worked to understand, refine, and apply. They were seeing "the development of the groupings…you can see that language development is happening, you can see that…activism is happening." They were witnessing "all those things that we always wanted" and were considering how the seeds that had been planted years before had grown.

Challenging situations that had extended across years had played a key role in supporting the change and growth in the aims of the team. For example, the scientific inquiry/design thinking dilemma that emerged in 2018 and continued through 2019, evolved in 2020 as the structure of our work shifted from one unified curriculum to a range of experiences that focused on various topics. One of the outcomes of that 2020 experience was the development of Alex and Imani's computer science curriculum that in 2021 continued as a virtual summer programming option for students and pre-service teachers who were still unable to participate in in-person experiences. The backbone of this curriculum was built using a design thinking process and focused on developing solutions that addressed issues of environmental justice.

In 2022 as Michael and Alex watched Citizen Scientist students prepare to present the findings of their three-week exploration, the two were observing students participating in an experience with a sharpened focus that intentionally pointed toward processes of scientific inquiry—especially data collection, analysis, and synthesis. Michael and Alex were also waiting for students who had spent three weeks participating in a new Digital Citizens pilot, students who had been practicing processes of design thinking as they developed prototype solutions for environmental issues that were relevant to the local community. It had taken five cycles of learning, collaborative planning, and implementation to identify a "yes, and" strategy for addressing our team's dilemma in ways that attended to the band-width, interests, and priorities of the group. Now we had built an approach that extended the ideas of the community between two curriculums that allowed us to include more students, more teachers, and a new path for exploration.

"It was watching something that you've spent so much time thinking about just become everything that you would have wanted it to be," Alex notes in reflecting on this moment. This is a moment that offers insight into the motivations of teaching as a "holistic act" (Goodwin, Lee, & Pratt, 2023, p. 708) that can be further enhanced through the satisfaction that comes from a vision realized. In this context, where creativity has been encouraged the momentum of the team has been sustained through as the team has learned to build bridges, break down barriers, lean into conflict, and negotiate for new ideas to be implemented. It is through these efforts that the team has begun to transform a vision of learning that has resulted in a change in us all.

Chapter 5: Lessons on Learning from an Intergenerational Teacher Education Community

Teaching is a complex, nuanced, and dynamic profession that must be supported by opportunities for teacher learning that are just as nuanced and complex (see, for example Cochran-Smith, 2001; Goodwin & Kosnik, 2013; Hoban, 2005; Loughran, 2007). In their design, opportunities for teacher learning must be acutely sensitive to teachers' continual endeavors toward *becoming specialists of learning.* These endeavors must aim to balance the contextual attributes of the local community, school, and classroom with the broader pedagogical, theoretical, social, and political particularities of learning. Without intention, processes of learning—for students *and* teachers—can quickly turn into experiences of *schooling* that are grounded in assumptions and expectations derived from stagnated conceptions of teaching. If we are not careful, these are then replicated as teachers repeat rote instructional approaches they observed as students without much thought about the implications of these actions (Goodwin, 2010).

When we cling to familiar approaches of teaching and learning we are also holding fast to entrenched educational habits that are rooted in and perpetuate systemic inequities (Ladson-Billings, 2014). These can be transformed only if we are willing to change the processes, practices, and conventions that hold them up. Even so, approaches to teacher preparation—a key element in establishing the foundational professional habits of teacher learning and, therefore, practice—have "shown [themselves] to be resistant to change" (Goodwin, et al. 2014, p.296) even as there is a crescendo in calls for better access, opportunities, and experiences for student learning on a global scale.

Instead of a change in teacher preparation, learning, and practice, what has resulted is an

"erosion of trust" (Daliri-Ngametua, Hardy, & Creagh, 2022, p. 2) in teaching as a profession and an increase in demand for standardization, accountability, and data-driven processes for "auditing, measuring and monitoring…a quantifiable version of the teaching self" (p. 3). This approach to education aims to increase the weight of metrics based on the "performance and outputs" (Daliri-Ngametua, Hardy, & Creagh, 2022, p. 2) of teachers with rhetoric claiming that clearly quantified outcomes of what students should know and be able to do will result in a more 'objective' approach to education. This framing of education contributes to feelings of suspicion toward teachers and schools even as professional agency and decision-making are constrained and taken from teachers' hands (Hardy, 2018). As they are implemented today, structures meant to ensure the quality and improvement of teachers, such as systems of teacher evaluation, "rarely help teachers improve" (Darling-Hammond, 2015, p. 1) their teaching practice and do not offer opportunities for deep, meaningful reflection on teaching. Instead, these ineffective systems constrain thinking about practice and fail to encourage professional growth in teachers as pedagogical problem solvers or innovators. These approaches offer too little insight in *how* to meet the needs of students on a local and individual level and instead mandate mechanisms that focus on defining *who* to blame or punish when externally established learning outcomes are not met. To often, these structures are experienced as 'gotcha' governance putting teachers on the defensive as they direct their efforts toward proving the value of their professional practice rather than focusing on enhancing it (Daliri-Ngametua, Hardy, & Creagh, 2021; Hardy, 2018). Children, young people, teachers, schools, and the field of education do not have time to helplessly wait on the sidelines or be distracted by these unproductive blame games of hot potato.

As a field, we need to reposition our attentions toward deep and intensive investigations

for enacting pedagogical practices that *do* align with rich and meaningful student learning for all. This reorientation toward *student* learning must begin with a reconceptualization of *teacher* learning as the knowledges, skills, and dispositions that teachers explore, refine, and master are those they also draw from as they teach. For example, "teachers with expertise in democratic group processes will naturally create classroom settings where cooperation, fairness, mutuality, and equality are the norms" (Goodwin, 2010, p. 27). Similarly, teachers who are anxiously engaged in their own processes of inquiry- and project-based learning have far more understanding of what it means to design spaces using parallel principles of learning for their students. This is less a matter of amassing a collection of 'tricks of the trade' and more about intentionally refining an ability to strategically problem solve, advocate for, and make decisions that directly address the learning needs of students in the classroom (Goodwin, 2010). Teachers must lean into the intricacies of pedagogical practice while accounting for both immediate and long-view possibilities of the learning community as students and teachers are met where they are, explore expanded opportunities that attend to their needs, and are supported as they move toward an ever-changing future. Indeed, if we are truly preparing students with the knowledge, skills, and mindsets they need to contribute to a transforming world then we must also approach teacher learning as a process of constant evolution. Moreover, achieving these aims requires that educators spend just as much time considering the *what, why, where, who* and *how* of teacher learning as we do of student learning.

When membership within a learning community represents multiple educator positions, then access to resources, perspectives, and opportunities for teacher learning are enhanced even further and become more powerful. "If we want schools to offer more powerful learning opportunities for students, we must offer more powerful learning opportunities for teachers –

opportunities that are grounded in a conception of learning to teach as a lifelong endeavor," (Borko, Koellner, & Jacobs, 2010, p. 548). For teachers, "powerful learning opportunities" (p. 548) must extend beyond a concept of individualized cognitive knowing, where the expectations for teacher learning are framed through a lens of individuality (e.g., one teacher and their learning) and where a teacher bears the primary responsibility for constructing and enacting their own professional learning (Lave, 2009). Learning is a social process—that is just as true for teachers as it is for the students whom they teach. This means that teacher learning needs to account for the situatedness of context and the socialness of the community as fundamental elements of learning (Lave, & Wenger, 1991). Still, the opportunity for learning in community consists of far more than throwing people together in a group. Rather, "powerful learning opportunities" (Borko, Koellner, & Jacobs, 2010, p. 548) require structures that meaningfully attend to theoretical principles of effective collaborative learning for students *and teachers* in contexts that involve processes of strategic problem solving and "building on ideas in shared endeavors" (Rogoff, & Toma, 1997, p. 471) in ways that attend to the complexities of learning and teaching practices. Establishing flexible infrastructure and taking actions that orient teacher learning in this direction can powerfully situate momentum for growth *within* communities of learning as members of the group progress in ways that directly and positively inform their teaching practice.

When elements of teacher learning that are geared toward refining the particularities of student learning are coupled with parallel opportunities to intentionally develop habits that lean into practices of *collaborative professionalism* then teachers are better able to engage in school communities as life-long learners (Hargreaves, & O'Connor, 2018). This orientation blends the learning and work of teachers as they come to focus on problems related to "how teachers and

other educators transform teaching and learning together" (Hargreaves, & O'Connor, 2018, p. 3) and "creating stronger and better professional practice together" (p. 3) as central elements to their own learning and professional growth. This perspective requires teachers to take a step back, reflect on the dynamic of teams of adults they are working in, and intentionally consider how to harness elements of learning within those contexts. Here, the orientations of teacher learning are less about making decisions *for* teachers about what they should learn and are instead about centering possibilities for engaging in learning *with* teachers.

When spaces for teacher learning prioritize decision making that happens within a community, teacher learning can be driven by the local and specific questions that are on the minds of teachers. The nature and combination of decisions being made within an intergenerational teacher education community tie back to the context, power, and influence of its members as a collective. It is the contributions of the membership that drive the decisions being made about where energies are focused, the direction of learning, access to resources, and the evolution of priorities in the community. This perspective offers a reorientation toward *collective* decision making that is grounded in *shared* endeavors as members of a community develop approaches to more fully align the multiple dimensions of a structure toward collaborative creation of the learning space (Ruvalcaba & Rogoff, 2022). For example, if decision making about what will be *done* (e.g., pedagogical approaches, curriculum design) is delegated to some community members but others hold all responsibility for decision making about *spending* (e.g., supplies, infrastructure), then these two groups will find themselves functioning within bubbles of unproductive power as they work toward misaligned ends with both missing pieces they need to influence important elements for change through learning. Here, one group has ready access to the resources, supplies, and infrastructure needed to *enhance*

and *extend* approaches of learning while the other has on-the-ground impact to *enact* experiences of learning that directly emerge from the design of the learning space. When the design and decision making that generate student and teacher learning spaces entwine representation across these multiple dimensions then actions can be taken that represent the needs of the community that account for pedagogy, structure, and resources in ways that are aligned toward common aims.

Developing a keen capacity to understand and contribute to these processes of collaboration, decision making, and ultimately change within an educational context requires a complex mixture of knowledges, skills, and dispositions that are rarely addressed in conversations about teacher learning—especially in the context of preparation of new teachers. These are practices that are particularly important to intentionally develop in pre-service and new teachers as they pair a fundamental sense of possibility in transforming education with concrete approaches to collectively enact change within the profession in ways that ultimately impact student learning. They are also practices that are best developed through participation and contribution to collaborative work that is grounded in teacher learning and aimed toward contextually specific educational change.

When membership in a teacher learning community is deliberately positioned across a continuum, it encourages the development of mindsets that honor the contributions and perspectives of individuals at varying stages of experience. Rather than dictating answers, teachers need spaces to explore these ideas as they are supported in asking questions, seeking insights, experimenting with instruction, and engaging in critical reflection with the aim of developing knowledge-of-practice as the community puzzles through processes of effectively aligning theory and practice (Cochran-Smith, Lyttle, 1999). Intergenerational teacher education

communities specifically address the intentionality of voice, representation, and experience in collaborative professional spaces while also incorporating opportunities to expand membership in ways that enhance perspectives, purposes, or priorities in relation to teaching and learning.

This framing sets aside requirements of expertise as a prerequisite to membership and instead prioritizes the intentional inclusion of members of the community who represent different levels and types of experience. In this case, the expectation within the community is not for more experienced community members to contribute all the answers or for less experienced members to come with only questions. Rather, it is for the community to engage in cycles of question asking and contribution making with attention being given to how the voices of all members are heard and knitted together. Instead of answers being defined by one or a few select members of the community, ideas from all are taken up, with bits and pieces being woven into a new approach that represents the shared ideas of the community. This requires that we rethink our purpose and approach to segregating groups of teachers (e.g., pre-service teacher vs. in-service teacher) and instead consider the layers of learning that can happen for a community of teachers who are in various places along a continuum and who are interested in participating in collaboration as a tool for learning.

The Citizen Scientist Curriculum Team offers one example of an intergenerational teacher education community engaged in that process of becoming a collective of specialists of learning. This process included consistent, on-going interactions that grew from the immediate questions, concerns, and interests of its members. It involved considerations rooted in theory and research on learning and teaching as the community worked to figure out what it meant to *put theory into action* on the ground, in real time, individually, and in community. Members worked to link the *what* and *why* to the *how* of student learning as the community experimented with

aligning our own connections, beliefs, and sensibilities about facilitating learning spaces with vital theoretical ideas. This resulted in collective shifts as the group discovered new orientations toward purpose, possibility, priority, and approach to learning for *both* students *and* teachers.

When collaborative attributes are incorporated and intertwined within a community, members simultaneously develop an individual sense of professional learning that relates to the work they are part of and skills they practice *and also* contribute to the development of a *community identity* that includes the cultivation of a collective set of knowledges, skills, and dispositions that grow and change in keeping with the group's communal work. For example, while *individual members* of the Citizen Scientist Curriculum Team grew professionally as they participated in the group, the community *collectively* became better at planning for, theorizing about, implementing, and reflecting on teaching and learning over the course of time. As *the community's* process became more complex and nuanced, the team's collective identity grew, changed, and became more pronounced. When new members of the group joined the community, they were entering a context informed by the history of learning shared by the collective, even as the group evolved as a result of continual lessons that informed growth. This process required that all members of the community contribute a hand in co-creating and participating in experiences of side-by-side learning which accelerated their development as teachers made connections between ideas they were generating and the practical application of them. In this context, learning was elevated as teachers became attuned to each other and actively engaged in lifting each other in practice. This is an approach of learning-by-doing that emerges as members of a group collectively work toward common aims and participate in collaborative critical reflection as *we* consider how *our* practice might be further enhanced.

This integrated process of individual and community *becoming* is complex, multi-layered

and can be amplified when members of the community represent a variety of backgrounds and various teaching experiences along a continuum of learning. For the Citizen Scientist Curriculum team, diversity of representation widened the range of perspectives offered within the group expanding our collective sense of possibility. While members participated in communal processes of planning, reflection, and experimentation, the individual lenses through which they interpreted the experience were driven by their distinct interests and priorities. These differences offered opportunities for invisible assumptions to be made visible as members critically interrogated their own and each other's thinking about teaching and learning.

When we create communal experiences for learning that embrace a breadth of perspectives, then multiple layers of learning begin to emerge within an intergenerational teacher education community space. For example, while the work and learning of certain members may be specifically focused through a lens of student learning, others may experience the same space (and even moment) in ways that also result in realizations of self-discovery as they recognize concurrent processes of student and self-learning. Likewise, some members of the community may simultaneously observe the learning happening between colleagues within the team as they consider how experiences of student learning are being enhanced. Still others may be particularly attuned to the opportunities of pre-service teacher learning that are afforded by a space and layer those considerations onto reflections of learning of teachers within the team.

For the Citizen Scientist Curriculum Team, these multi-layered paths of observation, consideration, and learning often played out in moments of action and insight that were embedded into the unfolding experiences of the community. They surfaced through the sense of security that Michael described as coming from the wall-lessness of the work as members of the community looked over to colleagues to learn from them at any time. They came from the

freedom from restriction felt by teachers like David to be able to "do the type of teaching and learning I was hoping to do." They could be found in the coupled elements of learning and trust that Lauren described as she reflected on co-teaching with Alex and emphasized their ability "to read" each other as central to supporting the learning of students. They emerged as the community asked questions about how to make student learning more effectively mirror the work of scientists even as we asked how we might more meaningfully enhance our own abilities to support student and pre-service teacher learning.

These multi-layered approaches to learning could also be seen in the teaching practices of Dan and Riko, two community members whose initial pre-service teacher learning experience intersected with the development of the Citizen Scientist Curriculum Team. These practices of multi-layered learning had been integral to their own preparatory experiences. As new teachers, when Dan and Riko accepted the responsibility for creating the Global Citizens Home Gardening Workshop, both were already accustomed to the practice of leaning into the expertise of all members of the community and were therefore able to develop collaborative opportunities that reflected the interests and varied perspectives of the group. As they invited pre-service teachers to join their team, the two already had a framework for enacting processes of shared thinking and decision making. Both understood that neither needed to come to the space prepared to deliver all the 'answers' and knew how to foster the process of community creation as a mechanism for learning to happen.

It is the *intergenerationality* of a community that makes these complex and multi-layered processes of learning possible. Individually and collectively, the expertise of an intergenerational teacher education community grows as members collaboratively roll ideas around, look at them from multiple angles, and critically develop concrete approaches for experimenting on those

practices. Through this process, both common (e.g., the members of our community believe that learning should be hands-on and connected to the real-world) and diverging (e.g., some of us want to focus on a scientific inquiry process while others prefer a design thinking process) perspectives can emerge as the community engages in pushes and pulls that ultimately stretch initial ideas in new ways. In this context, change comes from collaborative creation as members set aside assumed answers and concrete notions of what can and cannot happen and replace those with practices that prioritize question asking and encourage collaborative conversations that stretch notions of what is possible within the group. In a context such as this, learning happens as the group takes up issues and questions of immediate importance and then experiments in cycles of reimagining, implementing, and reflecting to enact professionally satisfying and sustainable changes in individual and collective practices.

In an intergenerational teacher education community, small, sustainable changes emerge from a focus on learning side-by-side, through experimentation, at every level of participation. The ultimate outcome of the work is not the catalyst for change as much as the on-going learning that happens day-by-day and eventually transforms the community and its members. This is a process that unfolds as members collaboratively work out new ways to implement their ideas (e.g., shifting instruction from a model of front of the classroom transmission of information to a more student-centered pedagogical model) across multiple contexts through shared thinking and experimentation (Ruvalcaba & Rogoff, 2022). As members become more adept at enacting their collaboratively generated ideas, their approach to teaching and learning naturally grows. Here, the nature of change is tied to issues that align with central priorities of the group that ripple outward to act as precedent and then influence related decisions within the context.

Just as the group's perspectives create complex combinations of learning within the

community, the target of change may also be just as varied with attentions shifting between the learning community, school, or university contexts. This happens as the community identifies barriers to and opportunities for learning that need to be addressed to enhance their own and others' experiences. Rather than a grand production, this kind of change aligns with the contextually specific questions-to-date (e.g., How do we increase the accessibility of meaningful experiential learning opportunities for students who typically have the least access to them? How do we make invisible pedagogical actions—such as rock sitting—visible for pre-service and new teachers? How do we enhance the dynamic of our team to elevate the ideas we are discussing?) and priorities-at-hand (e.g., establishing mechanisms for turning a summer experience into a credit-bearing course, connecting the work of the community to a pre-service teacher preparation course, establishing a new partnership that will result in a new site for students to collect data) of members within the community and develops in keeping with the capacity, time, and interests of the group. This is a transformation that is more about *how we change ourselves* than looking over at others and trying to dictate the change in them and is characterized as *one small step* or as "little by little, a little becomes a lot" (Tanzanian proverb).

When taken in concert, three overarching elements of an intergenerational teacher education community can be illustrated in a three-dimensional model where the lenses of student, self, and peer development that make up teacher learning along a continuum are represented on the *x* axis whereas the interlaced elements of team, school, and university change are represented on the *y* axis. The element representing the final *z* axis is the learning space itself that is grounded through the creation of a common aim that can be collectively taken up and serves as a unifying factor that binds the community while providing depth to shared learning and work. The *z* axis offers a level of communal concreteness to the group as they apply their

questions and efforts in a common direction. This shared purpose drives decisions of the group while offering a collective context for experimentation of practice that can then be applied elsewhere. The July Citizen Scientist Summer Program acted as the anchoring experience that defined the development of the learning space represented on the *z* axis for the Citizen Scientist Curriculum Team. Decisions being made by the group pointed toward envisioning and enhancing the experience represented through this concrete context. Even as specific actions were developed in relation to the implementation period and teachers practiced strategies, engaged in conversation, and pushed each other in practice, they developed ideas for extending these principles into other professional contexts. These *permeable* boundaries (Lee, Akin-Sabuncu, Pratt, 2024) opened notions of *who* was learning in the space, *what* mattered most, *where* it would be applied, and *how* it would be developed and were vital in establishing a general culture that fostered a shared expectation that in this space we are all active participants and contributors to the learning that is happening.

Too often learning spaces are conceptualized in ways that encourage *impermeable* divisions between teacher and learner. In teacher education, this hierarchical structure can be seen in the positioning of university-based teacher educators as approaching "second-order" practice or "induct[ing] their students into the practices and discourses" of teaching (Murray & Male, 2005, p. 126) in ways that limit methods and strategies to those that are detached from the work of "*first-order practitioners*—that is school teachers" (p. 126). When teacher educators learn and work in spaces that are theoretically and practically separated from teachers and schools, then they situate themselves in ways where they may "forg[e]t what it was to be a teacher" (Kessler, 2007). This can result in pre-service teacher coursework that superficially addresses *ideas* of teaching without providing the learning opportunities for them to grow "as

thinking, inquiring, and decision-making professionals" (Kosnik, 2007, p. 18). Indeed, if we want pre-service teachers to develop a capacity to "see into teaching" (Loughran, 2013, p. 5) then that learning must include opportunities to think, learn, and reflect in ways that encompass genuine perspectives of teachers, children, young people, caretakers, and community advocates who, on a daily basis, are living and/or practically applying the ideas being discussed.

Recommendations for Practice

The Citizen Scientist Curriculum Team offers an example for thinking about teaching and learning that underscores the importance for creating open, flexible opportunities for teacher learning where practice can be investigated, and questions can be explored. In the case of the Citizen Scientist Curriculum Team, the university-based residency program played an important part in fostering a space where teachers could collaborate between schools, across disciplines, and along a continuum of teacher learning. The residency program came to act as a hub (Lee, Akin-Sabuncu, Pratt, 2024), or central access point, for learning about teaching as ideas were co-constructed, collaboratively interrogated, and collectively implemented. Because of the permeability of boundaries, the opportunities for pre-service and teacher educator learning also became apparent within the space. This complex ecosystem of learning offers practical lessons for designing rich and robust pathways for teacher learning and also requires that we re-think pre-conceived roles that represent who is a knower, a teacher, and a learner.

For example, university-based teacher preparation programs are well situated to act as contributors to teacher learning ecosystems but those contributions have to be directly beneficial to teachers in the schools with whom they partner. This means that teacher educators need to come to the community ready to contribute in ways that work for the collective. This may require teacher educators to reframe their presence and to focus on listening, asking questions, and

stepping back to create space for the ideas of others. Teacher preparation programs have historically expected schools to welcome pre-service teachers into their classrooms with open arms as they complete field requirements. How might those same programs hold themselves to equal standards by considering how to reframe university-based learning spaces as opportunities for side-by-side experiences of project-based learning for teachers? While this may require a transformational shift in the ways that teacher preparation programs are enacted, it also offers a natural avenue for adding curriculum that accounts for teachers developing the knowledges, skills, and dispositions needed to actively work and learn on collaborative teacher teams. If we want teachers to be able to transform opportunities for learning, then they need access to spaces where they can learn through enacting the changes they envision.

Similarly, school and district leaders have preconceived visions for and structures that inform the kind of collaboration and decision-making taking place in their schools and districts. These practices may or may not align with the principles of practice that are necessary for communities to work and learn in intergenerational teacher education communities. Leaders need to ask questions about where and when learning happens in a school and district context and how this connects to changes that are being implemented. If leaders are not listening to, collaborating with, and working alongside teachers, then they are ignoring a key factor as they fail to recognize a group who have the capacity to act as catalysts for change. In the long run, without the active contributions and buy-in of teachers (enacted through their work and learning), the visions of school and district leaders will result in little more than wisps of smoke on a windy day.

Intergenerational teacher education communities offer an opportunity of teacher learning that is grounded in collaborative and community-focused conceptions of learning while emphasizing the open-ended nature of the process. The endeavors of this kind of community

blends learning with the real work of teachers in an aim to design rich, meaningful learning opportunities for students. The eventual aim of this work is to enhance student understanding in ways that results in students developing "sophisticated insights and abilities, reflected in varied performances and contexts" (Wiggins, & McTighe, 1998, p. 5). Similarly, the nature and aim of *teacher* learning can be conceptualized in a parallel vein to "transcend the practicalities (and limitations) of discrete teaching skills and tools, to develop in our students ways of thinking about and approaching teaching and learning that promote the application of a professional repertoire to a vast array of problems an dilemmas, most of which cannot possibly be anticipated beforehand" (Goodwin, 2010, p. 22). With this in mind, what might a curriculum of teacher learning entail? Figure 5.1 offers one articulation of big ideas, essential questions, and enduring

Figure 5.1 Framework for Intergenerational Teacher Education Community Learning

Big Ideas	Essential Questions	Enduring Understandings
Teachers learn and grow when we have a space for experimenting with instruction, curriculum and pedagogy.	How do we push the boundaries of our teaching practice in order to enrich student experience and accelerate their learning?	The best way to enhance the learning of my students is to enhance my own teaching practice.
Teachers learn and grow when we have an opportunity to work with others who have different resources and kinds/amounts of experience.	How do we challenge our visions and assumptions about what teaching/learning look like in the classroom?	No matter my level of teaching experience, I grow as a teacher when I collaborate with others to expand our vision of teaching and learning.
Teachers learn and grow when we intentionally make space to develop practice and refine our habits of collaboration.	How do we support each other in our efforts and endeavors to develop new ideas and enhance our teaching practice?	My teaching practice has exponentially greater impact when I unite my efforts with other like-minded individuals who are passionate about growing as teachers.

understandings designed to align with principles of participation on an intergenerational teacher education community. Fundamentally, a curriculum of teacher learning in this context must be grounded in opportunities to engage in teacher learning that informs understanding of self and others (e.g., students, the team, other colleagues, pre-service teachers) through multiple layers. A focus on the development of collaborative community-based spaces for learning encourages teachers to experience and engage in pedagogical practices that foster opportunities for inclusion, contribution, collaboration, and shared thinking. Sharing a common project to be implemented offers a common aim that grounds the side-by-side work of the group.

Recommendations for Research

The case of the Citizen Scientist Curriculum Team offers insight into the opportunities and learning that can come from the creation and on-going development of an intergenerational teacher education community. The findings of the study align with calls from others for additional research in "conceptualizing hybrid spaces in teacher education" (Zeichner, Payne, & Brayko, 2015, p. 124), "strengthen[ing] the link between university-based and school-based knowledge about teaching" (Daza, Gudmundsdottir, & Lund, 2021, p. 2), and "reclaim[ing] …*democratic accountability in teacher education*" (Cochran-Smith, et. al., 2018, p. 3).

Additionally, this study's long-view perspective emphasizes opportunities for exploring processes of learning that extend beyond the rhythms of a one-year academic cycle. More longitudinal studies that account for this are especially important as "in education, '[m]eaningful change is slow: there are stellar moments, but real change takes time and patience'" (Murray, 1998, p.3 cited in Saldaña, 2003, p. 12). Investigating professional learning progressions of teachers over time encourages us to develop a deeper understanding of the relationships between learning and practice. This requires us to ask questions about *how* masterful teaching happens

that set aside quick fix references and instead encourage questions that lean into the complexities of learning and practice in the teaching profession.

These are complexities that warrant further study, especially as they relate to our understandings of collaboration and shared decision-making in fostering strong team dynamics in teacher learning contexts. The scope and point of reference in studies on teacher learning most often point toward topics that emphasize actions and practices meant to improve student-facing instruction. However, as seen through this study, when teachers take time to point their attention toward developing the capacity to work collaboratively and creatively as teams, it serves to expand their reach and deepen their practice. Because of this, additional research that focuses on creating spaces for learning that emphasize more deeply understanding processes and practices for developing strong team dynamics is warranted.

Additionally, while school leaders played only peripheral roles in the case of the Citizen Scientist Curriculum Team, there is certainly an opportunity to explore other configurations of intergenerational teacher education communities that intentionally include school leaders in the community. This aligns with research on leadership where "ineffective…top-down policy solutions" (Hargreaves, 2018, p. 15) are set aside and replaced with the establishment of collaborative teams. I would argue that framing these communities as both learning and working spaces offers opportunities for even more expansive change—an idea that requires further research.

This case also offers an example for approaches to teacher education that prioritize question asking, listening, and doing work together side-by-side as important features to teacher learning. Further study needs to be done on how these might inform a transformation in teacher learning as the regular work and learning of teacher educators comes to more centrally include

collaboration with schools and teachers and the regular work and learning of teachers comes to include collaboration with universities. What are the variations of this practice that might represent more permeable boundaries between these two locations of learning?

In addition to the more longitudinal lines of inquiry outlined above, a set of more discrete studies focusing on the micro-actions related to communication, collaboration, and decision-making within intergenerational teacher education communities offer important next steps in thinking about this work. For example, in writing this study, the most helpful resources I read about collaboration used research methods that looked closely at distinctive interactions between adults and children in multiple cultural contexts (see for example Alcalá, Rogoff, & López Fraire, 2018; Rogoff, 2006; Rogoff, & Toma, 1997; Ruvalcaba, & Rogoff, 2022). The careful observation of these very specific interactions offered important insight into patterns and practices of collaboration and originated from communities where sophisticated approaches to collaboration were a particular strength. The close, detailed observations emerging from this research contributed to my own understanding of collaboration, informed my perspectives of analysis in this study, and enhanced the practices of the Citizen Scientist Curriculum Team as I shared what I learned. Engaging in studies that can offer insight into the micro-actions that contribute to a strong team dynamic, perhaps through study of practices such as sophisticated collaboration, decision-making, or communication offer a vital line of inquiry that could be invaluable in deepening our understanding about how meaningful teacher learning spaces are formed.

Finally, understanding these distinctive elements of community participation are key factors in also understanding ways that individuals contribute to and develop a sense of membership within a team. This illustrates a final line of inquiry focused on better understanding

the relationship between the development of individual and collective identity as a factor of learning within the teaching profession. If we better understand how to create spaces where teachers feel a sense of belonging and pair that with a space that motivates intense inquiry than it is these attributes that they will also be able to bring in the experiences of learning for their students.

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