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9. ELEMENTARY SCHOOL TEACHERS CONSTRUCTING TEACHER-OF-SCIENCE IDENTITIES

Two Communities of Practice Coming Together

INTRODUCTION

In US elementary schools and especially in early grades, there is a heavy emphasis on English language arts, often to the exclusion of other subjects, such as science and social studies (Crocco & Costigan, 2007). This, coupled with many elementary school teachers seeing themselves as more "literacy people" rather than "science people," encouraged us to conceive of a project *Integrated Science Literacy Enactments* (ISLE) that aimed to develop, enact, and study integrated science-literacy teaching and learning in urban elementary school classrooms (Varelas & Pappas, 2013). In this chapter, we report on a group of elementary school teachers in an urban district who participated in the ISLE university-school partnership aimed at developing and investigating curricular and instructional practices that nurtured young children's engagement in, and learning of, science using a variety of literacy tools (e.g., read-alouds of children's literature science information books, journaling, etc.) along with hands-on explorations. With this study, we explore the ways in which the teachers, who mostly taught predominately students of color whose families were facing economic disparities, positioned themselves, and their students, in the course of a school year within the project's professional learning community and how they constructed teacher-of-science identities as they were also constructing their students' science identities.

The curriculum that was co-designed by the ISLE team, consisting of university-based educators and researchers and public school teachers who taught 1st, 2nd, and 3rd graders, included two extended science units that aimed at helping young children learn both science content and science discourse genres. The two curricular units, *Matter* and *Forest*, that accounted for a whole year's science instruction, were developed to offer children opportunities to engage with non-fiction science texts, material objects, ideas, and representations through various curriculum genres (i.e., read-alouds of non-fiction science books, hands-on-explorations, journaling, semantic mapping, literature circles, drama, mural making, home projects, and information book making).

The ISLE team valued, worked towards, and studied ways in which science classrooms become sites where both teacher and student voices are privileged in collaborative transactions. An important part of the teacher's role was conceptualized as skillfully listening and facilitating student engagement with ideas and with each other, and encouraging reasoning, meaning making, and questioning during dialogically organized instruction in whole-class and small-group settings (Kane, 2015). Moreover, the ISLE professional learning community espoused the importance of avoiding logocentricism and the dominance of written or spoken language as the only form of communication in (and out of) the classroom, and of complementing language with other modes (e.g., images, concept maps, dramatic enactments, etc.) as valuable representational systems for thinking and communicating (Jewitt, 2009; Kress, Jewitt, Ogborn, & Tsatsarelis, 2001). In the context of these values that characterized the ISLE community and the teachers' own classroom communities where they enacted the curriculum that the team had designed together, we undertook the study we present in this chapter, to explore teacher identity at the crossroads of two communities of practice–the ISLE community and science classroom community–both committed to dialogicality.

THEORETICAL FOUNDATIONS

The study draws on several theoretical frameworks to explore the connection between the construction of identities and dialogicality within the two communities of practice–a teacher's own *science classroom community* where teacher and students interacted with each other and with science for a whole year, and the *ISLE community* where all the members met every week interacting with each other thinking about science teaching and learning in the teachers' classrooms.

Communities of Practice

Lave and Wenger's (1991) notion of participation in communities of practice provides a framework in which to think about the collective learning of something for which a group of people shares an interest, common goal, or passion. Wenger (1998) outlines four interconnected elements of social participation as a process of learning: community, practice, meaning, and identity. In Wenger's framework, *community* involves the mutual engagement in collective pursuits via shared history, ideas, tools, discourses, actions, stories, and so on. A given situated set of *practices*– shared relational, semiotic, and material resources–facilitate participation across activities and allow participants to become more fully engaged over time. Access to authentic participation is essential if participants are to develop an individual and collective sense of *meaning* in the process of learning and becoming members of the community. Focus is on the process, on learning *to* talk, not simply learning *from* talk, on talk that occurs *within* practice, not just *about* practice (Lave & Wenger, 1991). In this framework, learning is a process of personal transformation or

changing *identities*–forms of participation, ways of seeing the world, ways of seeing oneself in the world, and ways of being seen in the world. For Lave and Wenger, social membership, meaning making, and identity construction entail one another.

Wenger (1998) identifies ways in which meaning making involves "negotiation" (p. 52), the gradual yet continuous give-and-take process of participation in social communities. Meaning making is the process of making sense of our engagement with the world and necessitates the convergence of "participation and reification" (p. 55). The intersection of *participation*, the process of taking part in activities with others, and *reification*, the giving of form and significance to those experiences by producing "objects," allows individuals to function and influence the communities of which they are members. In the ISLE community, as teachers participated in planning science lessons and reflecting on their teaching and their students' learning, they produced accounts of their classroom experiences which positioned them as particular kinds of teachers of science. The teachers' accounts of their classroom practice became sites of construction of "identity-in-practice" (p. 149) in the ISLE community.

Wenger (1998) also specifies three distinct, yet interrelated "modes of belonging" (p. 173) to communities of practice–engagement, imagination, and alignment– that influence the formation of identities. *Engagement* entails the interactions and relationships within shared practices and a common history of learning. *Imagination* involves the past, but also the future images that one creates of possibilities for the world and self. *Alignment* requires a certain amount of coordination of speaking and acting within the community of practice. Belonging to a particular community of practice necessitates common understandings of engagement, imagination, and alignment within the time-space of that community. Members of the community must take part in, as well as have access to, the activities of the community, but also members must be open to exploring and taking risks with the assumptions of the community. At the same time, members need to connect their efforts under a common orientation to the goals and aspirations of the community. By actively participating in these modes of belonging, members of a community of practice form identities that further nurture their ties to the community and each other.

Identities-in-Practice

In Wenger's (1998) framework, identity is both a means for, and an outcome of, participating in communities of practice, "the social, the cultural, the historical with a human face" (p. 145). Moreover, "We not only produce our identities through the practices we engage in, but we also define ourselves through the practices we do not engage in" (p. 164). Holland, Lachicotte, Skinner, and Cain (1998) connect the notion of "authoring selves" (p. 169) to Wenger's work, and also highlight the multiplicity of *identities* that are produced while engaged in a community of practice. "*Identities*-in-practice" captures ways of being and ways of making meaning of the self within a particular context and in relation to others, in part by being recognized by others as a particular kind of person. Holland et al. also point out that committing the self

to participate fully, including identifying oneself with the practices of a community is also a part of identities-in-practice. Identities-in-practice are possibilities enabled by participation and reification within a particular community, which are not solely determined by the community and its structure, but also by people's individual and collective agency (Varelas, Settlage, & Mensah, 2015).

Furthermore, the ways in which people perceive themselves in particular communities is related to the roles they hold in these communities (e.g., a classroom or a professional learning community), and these roles are influenced both by the structures defining and governing these communities and by choices people make that produce new practices. "The identities are the meanings one has as a group member, as a role-holder, or as a person" (Stets & Burke, 2003, p. 132). As people's roles within particular social contexts are negotiated and change over time, so do these meanings, identities. In this study, we examine how teacher-of-science identities were constructed within the ISLE professional learning community as the teachers' "internalized positional designations" (Stryker, 1980, p. 60) in the context of their classrooms were negotiated, discussed, reflected upon, and made sense of in dialogue with fellow educators.

Dialogicality

Bakhtin (1981) suggested that people are always in dialogue not only with other people but also with themselves and with everything in the world. For Bakhtin, it is the participation in dialogue that transforms people as they encounter multiple voices and perspectives. Moreover, each voice and perspective becomes valid as speakers interact and incorporate others' voices into their perspectives. As people participate in communities of practice they draw on and use various semiotic resources, in addition to material resources, that support authentic participation (Lave & Wenger, 1991). Dialogism or dialogicality makes such use possible, which leads to further construction of identities-in-practice (Holland et al., 1998).

Furthermore, a dialogic approach to teacher learning encourages us to consider the two discourse genres that Cohen (2010) identifies–personal storytelling and analytical talk–that can support teachers when they reflect on and make meaning within a professional learning community. Personal storytelling, the retelling of personal life experiences in the context of their work in their classrooms, and analytical talk, describing and explaining reasons for curricular and instructional decisions, become bids for recognition as particular kinds of teachers among their peers. The ISLE learning community included both discourse genres and offered the context in which to interrogate how teacher-of-science identities are constructed as science classroom practices and experiences are narrated, analyzed, and reformed.

THE STUDY AND ITS CONTEXT

The ISLE professional learning community consisted of six elementary school teachers from five urban public schools in a large Midwestern U.S. city, and eight

university-based educators and researchers (two professors and six graduate students, one assigned to each of the six classrooms). Table 9.1 summarizes demographic information of the teachers and their classes in the year of the study.

Table 9.1. Teacher and Student Information

Teacher	Years of Teaching Experience	Teacher Race/ Ethnicity	Grade Taught	Student Race/ Ethnicity	Free/ Reduced Lunch	Number of Students Per Class
Anne Barry	35	European American	1	Latino/a	94%	21
Begoña Marnotes Cowan	13	Cuban American	2	Diverse	60%	27
Ibett Ortiz	8	Mexican American	2	Latino/a	95%	21
Jennifer Hankes	7	European American	3	Black	98%	21
Neveen Keblawe-Shamah	5	Palestinian-American	3	Latino/a	95%	29
Sharon Gill	32	African American	1	Diverse	40%	30

For more details on schools and classes that the teachers taught, see Varelas and Pappas (2013). The teachers taught science about 2–3 times a week for about 60 approximately hour-long lessons over the school year. The science lessons were designed by the ISLE team during the previous school year and summer, and were organized around two units. The *Matter* unit addressed concepts such as solids, liquids, and gases, what they look like, how they are similar and different, changes of states, such as melting, freezing, evaporation, and the water cycle. The *Forest* unit addressed characteristics of, and relationships between, plants and animals living in a temperate forest, including ideas such as, what plants and animals look like, where they live, what they eat, what they are eaten by, how they reproduce and grow, and how they protect themselves.

Throughout the year of the study, the ISLE team held weekly meetings of 90 minutes each from September to May, for a total of 30 meetings. All teacher meetings were audio recorded. They were semi-structured with room for curriculum clarification, logistical details (e.g., distribution of materials), and teacher reports in which teachers talked about their teaching and their students' learning, their progress in terms of the designed lessons, and any questions or concerns teachers wanted to discuss. Questions spanned a range of curricular and instructional issues as well

as science ideas. Teachers asked each other about how various lessons unfolded in their classrooms and told stories about their students' responses to the science ideas and activities. At the end of the year, conversations with individual teachers and university-based members of the team took place and ranged from 80 to 120 minutes each. In these conversations, the teachers recounted experiences and identified understandings they had constructed that they considered pivotal as teachers of science. The recorded discourse in team meetings and end-of-year conversations provided the data for this study.

   To analyze these data, we used In Vivo coding (Saldaña, 2013), identifying initial quotes and composing analytic memos for all the instances when teachers described themselves or their students' relationships to teaching and/or learning science, ways they perceived themselves as teachers, and ways in which they connected their own experiences to their students or others in the ISLE team. We, then, organized the quotes into categories/codes (e.g., student understandings, students' ways of being in the classroom, teachers' experiences, teacher questions/concerns, etc.) and continued to compose analytic memos. Weaving the codes and memos together we identified three themes that we use below to organize the findings: Ideas, confusions, meaning making; Social spaces, interactions, and learning; Affect, interest, and ways of being.

IDENTITY CONSTRUCTION AND TEACHER LEARNING ACROSS TWO COMMUNITIES OF PRACTICE

During their participation in the ISLE project, teachers went back and forth between two communities of practice, their own science classroom communities and the ISLE community where, in the midst of other teacher colleagues and university-based educators and researchers, they supported each other's development and enactment of science linked with literacy in their classrooms. The teachers' membership and participation in these two communities were unfolding at the same time–the teachers were teaching children science 2–3 times a week in their classrooms *and* they were members of a professional learning community throughout the week, too, having brief apropos conversations with research assistants while in their science classrooms and with the whole ISLE team once a week.

   As the teachers were developing meanings as members of both the ISLE community and their own science classrooms and as role-holders in both these communities, they engaged in the cognitive, social, and affective dimensions of teaching and learning science in intricate ways and they positioned themselves as certain kind of teachers in general, and teachers of science specifically. Along each of these dimensions, particular meanings were reified, gained legitimacy, and became part of the teachers' positioning both as *teachers* who were attending to their students' engagement with, learning of, and identifying with science, and as *learners* whose meaning making, quests for understanding, and triumphs and challenges were attended, too.

Ideas, Confusions, and Meaning Making

The teachers saw the ISLE community as a time-space where they could "have discussions and ask questions and really learn from each other…[where they] would hear things at our meetings and…take it back and try it" (Anne). The questions the teachers asked at times emerged from their attending to their students' meaning making and realizing that they might have been more confused than their students. As Duckworth (1987) pointed out almost three decades ago, we all need "time for our confusion" (p. 82), and this is true for teachers as much as it is for students. In their classrooms, the teachers in this study were positioning themselves as teachers who valued how their students made sense of science ideas, but also realized that they may be hampering their students' meaning making if they themselves could not see its "beauty." This realization happened at the cross-section of the two communities of which they were members.

One example is a discussion during an ISLE meeting when several teachers spoke about the confusion of some of their students regarding whether salt was a solid or a liquid. In a sorting activity during the *Matter* unit, students were given multiple objects to sort into solid, liquid, or gas categories and provide reasons for their decisions. Some of the objects were purposely ambiguous (Varelas, Pappas, Kane, & Arsenault, 2008), namely, a baggie with salt and a baggie with shaving cream. Students worked in small groups to discuss their ideas as teachers circulated among them. In several classrooms, some students argued that salt was a liquid because you "can pour it" and/or because the salt "took the shape of the container," both properties of a liquid that the students were learning about. The teachers knew that salt was a solid, but they considered these students' reasoning as valid too, so they themselves became confused. The ISLE community offered the teachers opportunities to consider this confusion with each other and construct the idea of a "unit." The teachers talked about the difference between the two conceptions of salt that their students brought to the table focusing on either the whole amount of salt in front of them or a grain of salt as the unit of reference. As the confusion was discussed, the teachers viewed the students who considered the whole amount of salt not as "wrong," but as thinking differently about the unit being sorted. Speaking of her classroom community at the end of the year, Neveen positioned herself in this way: "Danita[1] said something really good with the salt…She said you could //[2] that salt was a liquid, not because you could pour it, but because it takes the shape of whatever you put it in…We talked about it and I told her to look at the one grain and how does that feel." The teachers recognized their students' "process of learning" (Ibett) and through their own process of being "reflective and conscious of what we were doing in the classroom," as Begoña noted about the ISLE community and the ways in which the teachers were making meaning in this community, were able to think about ways to guide their students through their own meaning-making process. Ibett realized that "they don't have to get it right away and…[this is] a good thing, like when the kids thought the salt was a liquid." Moreover, Ibett realized that she

was "lucky I work in a school where they encourage us to display work that shows the students' process of learning. Sometimes this is hard to explain to other teachers or parents, but I think it is more like how kids really learn."

Over time, as teachers used the ISLE community to think about their classrooms as communities of learners, they crystalized different parts of their role in supporting their students' engagement with science ideas. Ibett spoke about how she came to see her role as a teacher differently, as supporting students' own explorations, saying, "I think one of the reasons why [I saw a shift in my teaching] was because we [teachers] changed. It is not as important what they [the students] get, [but] to kind of just let them explore…I liked the way // the conversations they were getting and I saw that they were actually understanding it more that way than as me imposing onto them. I think that was the big turning point for me." The read-alouds of non-fiction science books coupled with hands-on explorations gave Ibett opportunities to let her students explore their own ideas about the world in the context of science discussions. Neveen appreciated children's literature science information books as a source of ideas for *both* herself and her students, as they were both learning from them. When asked what she might do differently in teaching science in the future, Neveen said, "I would use more non-fiction. I always thought it was harder and I didn't know what to do with it, harder to come up with things if you're not a scientist…[but I realized that] the more interested [students were] the more they retained. I know I have to bring in more [non-fiction science] books." Anne saw herself as leveraging her participation in the ISLE community to "further mushrooming what we do…[so that science is] tucked in" across the curriculum and especially into language arts, a structural change that would be offering her students more opportunities to engage with science ideas. The teachers saw their roles changing to facilitators of children's exploration of science ideas as they were developing and using literacy tools and hands-on explorations in their science classrooms.

The more teachers worked with each other discussing ways in which they and their students engaged with science ideas, the more they problematized aspects of their instructional practices in their classroom communities. Jennifer realized that she asked too many "yes-no questions," and "moved on too quickly without asking why." She realized that she needed to learn to ask open-ended questions and facilitate discussions that would help her students develop their own understandings. The ISLE community offered her "a huge opportunity to see how science could be taught." As she imagined and discussed science teaching with peers (school- and university-based educators), she developed new models for teaching, stretching the boundaries of her teacher role. As she was offering her students opportunities to contribute in the classroom, she first noticed that her students were indeed listening to each other. This led her to more unsettling as she realized that she needed to give them the space to respond to each other. As she tried to honor and nurture their meaning making, she also struggled with handling some of the questions that her students asked as a result of the spaces she created for them to engage with science. During the mural activity in the *Matter* unit, Jennifer shared, "The kids were labelling everything in

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the mural and Lawrence asked 'what is the sun, solid, liquid, or gas?', and I didn't answer his question so I don't open up a new can of worms." Jennifer realized that Lawrence's question would take her and the class into a discussion about what the sun was made of and she was not prepared for that. Furthermore, she did not quite know the composition of the sun and how to handle Lawrence's question. As she was changing her practice, she had not figured out what her role could be when her students were asking questions for which she did not have an answer.

Similarly to Jennifer, Ibett positioned herself as a teacher whose practice was changing. "They [students] asked a lot more questions in the *Forest* unit, but I think it was because in the *Matter* unit I found myself asking them questions that I was looking for the right answer so they weren't really open-ended questions." She also noticed, "At end of the *Forest*, when someone would say a comment, the kids would ask them 'Well why do you think that?' among themselves. It was them, more them than me. I really didn't say too much. It was mostly them." Ibett not only became a teacher who would let her students ask most of the questions, but she also linked this practice with a changing goal she had as a teacher. "I think the biggest thing for me was just letting them explore their ideas whereas…[in the *Matter* unit], I was very concerned that they get it. 'Did they understand evaporation?' In the *Forest* unit, I did more letting them explore, get the basics and try to understand it on their own at their own level, as opposed to I wanted everyone to know the water cycle in *Matter*, and [in the *Forest* unit], I felt like, you know, Enrica understands it and maybe Sonrisa doesn't, but she understands what she can handle at that moment. That was one of the biggest differences with me…I think if I had to choose a lingo for that, it would // it would probably be differentiating instruction…I felt they didn't all have to know exactly the same thing." The teachers were exploring their classroom practice, legitimizing changes they were undertaking in the context of institutional "lingo," as Ibett noted, as at the same time they were legitimizing their students' exploration of science ideas.

One of the elements that supported the continuous development of teacher identities–the meanings they were constructing as members of both communities of practice and as role-holders in these communities–was the creation within the ISLE community of spaces where teachers valorized their students' meaning making, engagement with science ideas, and taking on a scientist role. Neveen noted, "I would suggest things as [what] scientists [are doing] and the kids would pick up these habits all on their own when doing science [i.e., asking questions, engaging each other in dialogue]. Students are curious about why things are the way they are and pay attention to details in what they were seeing in the text especially if one text did not seem to agree with another. Students showed what they were learning by the questions they were asking. I didn't realize they were learning some of the things they were learning because I thought they were just fooling around in their small groups, but they were questioning each other and building on each other's ideas because this is what scientists do." As Begoña talked about specific students in her classroom, she linked their positioning as scientists with bringing into the classroom

community science entities in their everyday world with the help of their families. "Rachel said that she didn't consider herself a scientist early in the year, but that changed as the year went along so that she did by the end of the year and her family was involved. David brought in owl pellets. Cassandra brought the crickets…Ingrid brought the hornet's nest and Guillermo brought in a bird's nest for the mural."

For Anne, "the pictures in [her students'] journals" offered them "the creative space [they needed]…the students' voices are heard in the pictures." Similarly, artifacts that students created in Jennifer's class to put on the class mural were objects celebrated and discussed in the ISLE community. Jennifer noted that her students suggested using "clear, invisible tape for water vapor...[and] to show air [while] the class has made a kite." Her students were making meaning via their representations of science ideas. Additionally, they had not only created representations that captured important elements of their meaning making, but they also attended to the position of these representations on the mural that Jennifer orchestrated. Jennifer put "vapor," represented by invisible, clear tape, only above the water body in the mural. "Latessa challenged me, 'but water vapor is all around us, Ms. Hankes!'" Jennifer shared. For Jennifer, this was evidence of students' powerful thinking that was part of who she was becoming as a teacher. Other manifestations of her students' meaning making were connections they were making (i.e., "between the drama activity and the hot and cold water and food coloring activity…people being cold and not moving much and being hot and moving around more") as well as arguing and challenging ideas not only with her but also among themselves (i.e., "students argued whether molecules are like magnets, it was a good conversation to talk about what molecules are. The kid who objected said 'can't be because you'd need another magnet to make water move' which happened in a small group when kids were writing in their journal what they have learned about solids, liquids, and gases, and changes of state").

Social Spaces, Interactions, and Learning

The social spaces of the teachers' classrooms and of the ISLE community cultivated the ways in which the teachers perceived their roles in facilitating their students' interactions and learning. "A lot of things we did were new to us and were underdeveloped at the beginning, but by working together, we developed the activities and saw which ones worked better and why and with which students" (Anne). The teachers' ways of working together supported changes in their perspectives about student interactions in their classrooms in the context of science activities and ideas.

Teachers spoke to each other frequently about the ways in which their students interacted with each other in the classroom. Students' ways of communicating with each other and the teacher were sometimes problematic for the teacher, and by sharing their experiences in the ISLE community, the teachers found encouragement to think more about them and to further problematize the source of their discomfort. For example, Neveen shared at one meeting that she became frustrated when she had heard one student repeating another student's idea. "I want them to listen to their

classmates so that they can work together, and it seems like they just want to talk." Neveen assumed that when one student repeated another student's idea or comment it was because the student had not been listening to his or her classmate. When Neveen shared this experience with her colleagues in the ISLE group alternative ways of thinking about her experience were considered. Members of the group suggested that sometimes a teacher might find subtle differences in an idea that a student repeats, such as when the second student adds detail that extends or enhances the first student's idea. For example, Maria shared, "One child says 'cloud' and the other says 'grey cloud.' The *grey* in the cloud could be loaded with meaning for that student." Or, Chris added, "Sometimes kids just need to repeat stuff in order to get it." As the ISLE team talked about Neveen's dilemma, students were being positioned differently: students may be repeating what another person has said in order to practice or try their ideas out or because they were adding some detail, specificity, or nuance to the meanings already communicated.

As teachers participated in the ISLE community, they often discussed their students' excessive talk in their classrooms, which could be a problem but also an asset that supported student learning. For Jennifer, students shouting out during a read-aloud caused tension as it presented a challenge hearing one voice over too many speaking at once. Jennifer claimed that she had "lots of chatty kids" and she struggled to balance increased student interactions with learning science. But she also noticed that, while in small groups and with the noise level quite elevated, students could engage in fruitful dialogue around the task at hand. Neveen, on the other hand, was more concerned about the time that conversations took. She felt she needed to move quickly from one point to another so that she could progress through the content. Discussions slowed that down. The teachers recognized that their roles changed over time in facilitating their students' interactions with ideas and each other. Toward the end of the year, Begoña realized that she was "willing to take a breath and take a step back and wait and see where the students are taking it, allowing for more discourse among the students." Taking time to be attentive to students' ways of asking questions or thinking aloud shifted for Ibett, too. She recalled, "[The conversation] was not so dialogic when I was rushing…but when I would sit back and let them talk, they would get it." One example Ibett mentioned was the "existence of air" activity during which the students submerged a clear plastic cup with paper towel stuffed in the bottom upside down into a pan of water to see whether or not the paper towel would get wet. Ibett noticed that the students did all the talking. "I didn't say too much. It was mostly them. Because there was so much talking among them, they had it before I realized it. They really did understand there was air in the cup. Enrica, Flor, and Carmen were telling each other why the paper towel didn't get wet. It was more them than me."

Throughout the year, all of the teachers mentioned one or more children who were difficult to manage. Talking together in the ISLE community about their experiences with particular children offered the teachers opportunities to see these children's needs and strengths and to see themselves as developing competencies to manage

the social spaces in their classroom. Ibett had a girl in her class who spoke a lot and had strong positions on science ideas, which she would not easily relinquish: "I have a little girl, Enrica, who won't change her mind no matter what. In the air and paper towels discussion, which was good, Enrica was thinking that the paper towel that was flat on the desk would dry faster and she would not budge. Flor was claiming that the little droplets [of water] had a hard time leaving from underneath [the paper towel] and Carmen realized that, if both sides were exposed, the paper towel would dry faster. But Enrica wouldn't change her mind. I just decided to leave her alone after we spent a lot of time on it and we weren't convincing her." Part of the difficulty in managing the social spaces involving Enrica was that she seemed to present her ideas as "right" and others' ideas as "wrong." Moreover, Enrica had a habit of telling "fake stories," stories that both her peers and Ibett would doubt being true, such as when Enrica shared during a read-aloud in the *Forest* unit that she "knew that deer rub their antlers on trees because her cousin told her." Classmates tended to respond to Enrica by casting doubt on her arguments and ideas. Ibett knew that Enrica "got on people's nerves and it would have been really easy to just tell her to stop talking," but after Ibett talked about this with her colleagues in the ISLE group she "could see that Enrica sometimes had good ideas. Maybe she just needed to talk them through and hear herself think." How other students in these social spaces positioned Enrica– and other students like her–was significant. During the *Forest* unit, Ibett shared that Enrica drew the seed coat and wrote a very detailed description. When she shared her drawing with the class, a lot of hands went up to challenge her drawing. Ibett wondered if that was partly due to the way Enrica would not listen to others' ideas and partly due to the ways she shared her ideas with others. Ibett's support of Enrica in those spaces, which was appropriated and reified in the ISLE community, gave Enrica a chance to share her good ideas, albeit leaving a not-so-positive impression on others. Other teachers also spoke about students whose status influenced their experiences in classroom social spaces as well. Neveen shared a story about a girl who said, "That is what I was trying to tell them!" when her peers did not listen to her ideas during the activity. The student's lack of status in the group influenced her ability to participate. In Begoña's class, William was a "junior Einstein," which left Begoña concerned about being able to open spaces for all the students to think and contribute. She found herself and other students routinely turning to William for the "answers," and discussed with the ISLE group how to help him feel welcome while also including his peers.

As the teachers were enacting dialogic teaching in their classroom communities, they were also pondering in the ISLE community how these dialogic interactions supported student learning. Begoña acknowledged that fruitful debates taking place between students helped her understand student thinking about ideas. Sharon was enthusiastic about the "great dialogue" she heard while the children were working in groups. She described a discussion about where to put the can of chicken noodle soup in the sorting activity: "They were arguing over where to put the soup, in liquids or solids. One group of children wanted to put the soup in the liquids category, all except

Demario who was the lone person in the group to say that the soup belonged in the solids category." Sharon was impressed by Demario's ability to hold his ground in the discussion and recognized his meaning making. "He was looking at the can itself while all of the others were looking at the liquid inside the can." But for Sharon's teacher identity, it was also important that special education students were equally finding their place and voice in her science class where she was creating spaces for dialogue and exchange of ideas. Talking about "Edwin, a special needs child who really got involved in mural making," Sharon shared with the ISLE group: "He made clouds blue and other kids were on his case asking, 'Why didn't you make the clouds grey or black? They should be dark.'" Sharon legitimized the approach that Edwin had taken who did not change his color. "Edwin made the clouds blue because he thought water was blue and clouds are made of water. This is really good for Edwin." Although Sharon knew that water is not blue, she saw in Edwin's representation an important idea: that clouds are made of water, water that often looks blue in nature. For Sharon, like for other teachers in the study, understanding children's ways of being among their peers was becoming an overt part of being a teacher.

Affect, Interest, and Ways of Being

Emotions were an important part of who the teachers were positioning themselves to be in both their own classroom communities and the ISLE community. At first, the teachers expressed doubts about their abilities to teach science, but those feelings changed over time. "I was reluctant to teach science because of my lack of strong science knowledge and my students knew I was learning with them...It was great to learn from other teachers [in the ISLE community]" (Jennifer). Begoña also "felt uncomfortable teaching science originally." Earlier in her teaching career she had volunteered to be a part of a committee that reviewed science programs for adoption by the entire district. This involvement helped her become "familiar with the process [of science curriculum]…so now it's more that I could design what I'm doing in the classroom and bring in the pieces and have it more tailored to my students." All of the teachers expressed more confidence in their abilities to teach science as the year was unfolding and at the end of the year. As the teachers expressed feelings of comfort, and the role that the ISLE community played in that, they were inevitably keeping an eye on how their classroom communities were evolving.

   Ibett liked the conversations that took place in her classroom and felt good that her students were actually enjoying their participation in science and "getting it." "I would definitely want to do [science] that way again and do more content-area read-alouds…Read-alouds were more dear to my heart. The students made good connections between ideas in other activities, but in the center was the read-alouds. The hands-on explorations provided tools for understanding the ideas in the read-alouds, but the kids had all kinds of questions in the read-alouds…lots of topics came up and connections that kids made with ideas in books we had read earlier." While participating in the ISLE community, Ibett was consistently sharing about her

students' meaning making and interactions with her and among their peers, as noted in the earlier parts of this section. As part of her teacher identity, she was celebrating her students' achievements, which in turn sustained her positive feelings in her role as their teacher.

However, although, like Ibett, other teachers also felt more attuned to teaching science at the end of the year, they were still not satisfied with their classroom practice. Referring to how much talking she did in relation to her students, Begoña commented, "I wasn't pleased [about how much my name showed up in the fieldnotes]. When it's dried up and on paper, it's hard to be pleased with the questions that you asked." Continuing to reflect on her own dialogic practice, she offered, "There is a fine line between lecturing and asking questions. There is internal guilt in me, like I'm not doing best practice, but at the same time it seems to work, but I don't want it to be focused [on me], you know? When I see my name [written over and over in the fieldnotes], I'm like, 'what did I do? Lecture?' There's a tension there." In the ISLE community, other teachers acknowledged the same tension, as their roles as teachers were changing, and, thus, their teacher identities were being transformed. Jennifer also felt critical of herself after reviewing the fieldnotes from her year of teaching. She lamented that she could "use the fieldnotes for the dos and don'ts of teaching." She saw herself as "in control of the dialogue, the questions that were being asked." Their developing teacher identities were intertwined with looking back at their practice, even when transformation was in progress, with lament and some degree of regret for not having changed their classroom communities more extensively and earlier.

For some teachers, the satisfaction associated with their science teaching was linked to what they perceived their students' attitudes and feelings toward science being across the school year. For Anne, the changes she saw in her students were gratifying: "For kids to see themselves as scientists, too, you know? [Believing] that they could do this, that they want to [do science] in their life, work, or just as explorers in their world." Sharon was happy that she came to be "a little more open-minded about students and what they can do and how it's important that we expose them to as much as possible and not let age be the determining factor." Positioning their students in different ways contributed to the joy the teachers drew from watching their students in their classroom communities. In listening to her colleagues in the ISLE community, Sharon realized that students across the grade levels responded in their own ways to the science ideas, and that made her feel at ease. "For example," Sharon shared, "In Neveen's class, the kid focused on the worms being the same sex where in [my class] the kids were focused on the fact that the worms pointed their heads in the direction they wanted to go and the poop. Different kids at different grade levels focused on different ideas." Being a part of the ISLE community helped Sharon see, and feel good about, how much her students were capable of even as first graders. She continued, "Neveen had so much to say that made me think." While Sharon "thought the [worm] poop would excite everyone," there were students who were excited by other aspects of the worm. This led Sharon to see her students and her role as a teacher in a whole different way. She said, "This proves that children

become what you tell them that they are. If you tell them that they are dumb, they are gonna act dumb. But we told them they were scientists and that's what they believed. I've heard people say that, but I saw it. Kids rise to the expectations. There are kids who want to be in my class because of the worms!"

An important part of how Jennifer, too, was thinking of herself as a teacher was noticing her students' newfound interest in, and emotions towards, science. Her students' "feelings and emotions" as they engaged with science were mediating her own emotions as a teacher. She shared,

> The kids were excited every day to see if I brought the thermometer outside to check the weather…at first the students called the thermometer "that thing" and with time they started to call it a thermometer…they would daily ask what the temperature was and they never used to do that…They loved the drama and, for sure, earthworms created a lot of conversation. The kids had feelings and emotions toward the worms and observing living things added an affective element, but also made it more scientific for them. They didn't want to hurt it [the worm], but when we read about worms in *The Log's Life*, we had great conversation.

As for Ibett, her students' excitement about science that she later learned about from a colleague at school was bittersweet as she craved to have experienced it for herself. After the school year was over, many of Ibett's students were in summer school:

> Right now most of the kids are in summer school and they had field trips to the zoo and the aquarium and the teacher who was teaching them commented to me, she was like 'What were you doing in your classroom?' and I asked, 'Why?' She said, '[The students] wouldn't stop talking! They are so good in science!' I was excited, but then I was like 'I should have been there! I should have experienced that with them!' The teacher continued, 'they would not stop talking and I couldn't believe the vocabulary they were using! They kept saying 'camouflage' a lot. It made me feel good. She said, 'They are phenomenal when it comes to science!' She couldn't believe how much they knew about it. That was exciting.

Their students' positive affect towards, and relationship with, science, which the teachers helped cultivate in their classroom communities, was an integral part of the teacher-of-science identities they were constructing.

TEACHER IDENTITIES-IN-PRACTICE: CONSTRUCTING NEW TEACHER AND STUDENT ROLES

Over a school year, the six teachers featured in this study constructed and reconstructed their roles as teachers of science vis-à-vis their students' roles as learners and as scientists. They did so as they participated in two interacting communities of practice, that of their classroom and that of a professional learning community (the ISLE

community) in which they were all active members. Both communities were significant, in complementary ways, for their developing identities as teachers of science.

As the ISLE community was committed to thinking about ways to value both students' and teachers' voices in the classroom, the teachers were challenged to try new ways of being with their students. Battey & Franke (2008) have argued that very little professional development makes its way into the classroom and that teacher professional development needs to be reconceived to include the development of identities in particular content areas (e.g., science). This study demonstrates the ways in which teachers' dialogic engagement not only with science content but coupled with teaching and learning foundational ideas within a learning community facilitated changes in the ways teachers spoke about and perceived their classroom practice and interactions with children. The ISLE community was a place where teachers and university-based educators and researchers collaborated and reflected upon science-teaching practice based on collective knowledge and expertise, respect for discussion, questions, exploration of alternatives, and development of a stance as inquirers. In that context, the teachers felt comfortable discussing their struggles and confusion as well as their successes and triumphs. As the academic year progressed, the teachers articulated their ability and willingness to take a step back and let their students' voices be heard more often and more noticeably in their classroom discussions and think more explicitly about the ways in which their students engaged with ideas and each other. The teachers listened to each other's ideas and brought them back to their own classrooms to see how they might work, and came to see their own students' ideas and ways of being in new and more positive ways. They also developed their own strategies for supporting their students' ways of making meaning, asking questions, and interacting with each other.

Dialogicality, and striving to enact it, was paramount in both communities of which the teachers were members, creating a bridge between these two communities of practice and offering the teachers opportunities to imbue with meaning their changing roles as teachers of science. The dialogic engagement within both communities offered teachers spaces to begin to recognize themselves, and be recognized, as particular kinds of teachers. Particular meanings and ways of being gained legitimacy. When the teachers shared accounts of students' ways of participating in science class (i.e., calling out ideas or talking to each other), they created opportunities to begin to see their students' ideas in novel ways and to position their students as particular kinds of learners. Thus, the teachers' accounts of their classroom experiences contributed to making sense of their changing roles as teachers of science and catalyzing future and continuous reshaping of their, and their students', roles. In other words, the teachers were (re)constructing identities-in-practice within the ISLE community by composing, sharing, and discussing narrative accounts of their practice in their classroom communities. Akkerman and Meijer's (2011) notion of multiple "I-positions" (p. 316) underscores identity as a dynamic process that unfolds as teachers negotiate within and among themselves the varying

ways of understanding their roles in the classroom as well as the shifts that are taking place in these roles. By positioning themselves as particular kinds of teachers of science, the teachers were able to take on new roles in their classroom communities. The teachers were also learners examining their practice and recognizing shifts in the ways they themselves engaged with science ideas and science teaching and also positioned their students and their students' engagement with science.

Teaching is not only a cognitive activity, but also an inherently affective experience that draws upon emotional understandings (Hargreaves, 2001). Similarly, identity building is an ongoing process that requires attention to the emotional terrain of one's own and others' ways of being. As Maulucci (2012) noted, emotions are integrally implicated in a person's identity, including teacher identity, as they "provide information about our concerns and, thus, provide a lens into which concerns are most salient to us and in which contexts" (p. 124). Emotions are also an important part of rational decision-making and are related to teacher beliefs about science or sense of efficacy in science or science teaching. The teachers in this study were attuned to their students' emotional responses to science class and their own emotional experiences of teaching science. As the teachers were developing spaces for their students to be scientists, use science practices, make connections between science ideas and their everyday experiences, argue and contribute their meaning making, they were noticing how engaged their students were (and especially ones who they had earlier positioned as strugglers), how happy they were to do science, and how interested they were becoming in science. These positive emotions that were percolating in the classroom communities, but also the frustrations the teachers felt (e.g., when their students would not listen to each other's ideas) were an important part of their being in the ISLE community where the changes in who they were as teachers of science were cultivated and validated. Moreover, as members of the ISLE community, they were looking for signs of pleasure, happiness, and interest to supplement their searching for evidence of student thinking as they were changing their roles as teachers of science in their classrooms.

Buxton and his colleagues (2015), considering the interplay of structure and agency in professional learning programs in the context of one such program (LISELL), highlight the importance of what they call "multiplicities of enactment," teachers' agentic, varied ways of bringing into their classrooms new pedagogical ideas. Although in this study, Buxton et al. do not explicitly link this to teacher identity, they demonstrate that teachers in their study who saw their students (emergent bilinguals) using scientific practices successfully, in turn, showed "stronger, more agentic teacher voices about ways in which they could use the LISELL practices to support their emergent bilingual students" (p. 498). In our study, the teachers' accounts of their classroom life revealed that they were enacting the integrated science-literacy curricular units that the ISLE team had designed together, and the underlining pedagogical principles, in ways that made sense to them and their students. These "multiplicity of enactments" in their classroom communities became objects of discussion and pondering in the ISLE community, nurturing the

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construction of teacher-of-science identities where students (and especially students of color who predominately populated the classroom communities), and their relationship with science, were seen in a new light.

With this study, we showed how intertwined teacher learning and identity construction were within a professional learning context for elementary school teachers teaching predominately students of color who mostly lived in neighborhoods facing economic challenges. As Wenger (1998) starkly noted, "because learning transforms who we are and what we can do, it is an experience of identity" (p. 215). Learning of ideas, content, or practices involves construction and reconstruction of identity–identity that is both influenced by the learning and also influences the learning. The professional learning community was structured in ways that offered the teachers opportunities to experience the dialogicality, meaning making, collaboration, and positive emotions that they were trying out in their own classrooms and reflecting upon. There were no designated, specific moments when the teachers were asked to think about themselves as teachers of science or to consider their identities as teachers of science. Rather, in this professional learning community, the teachers continuously focused on their students and their roles as teachers of their students–their students' meaning making and thinking, how their students were seen in the classroom by peers and teacher and thought about their own selves, how the instruction the teachers were orchestrating was supporting or not their students' learning of science ideas and interest and positive emotions toward science. As the teachers recounted events from their classrooms between themselves and their students or among students, and listened attentively to each other as well as asked questions about, and discussed, science ideas, pedagogical dilemmas, instructional strategies, or curricular decisions, they (re)constructed their roles as teachers vis-à-vis their students' roles as learners and as scientists. Thus, student identity–in the sense of roles that students were seen by their teachers as taking on or should be taking on in science class–was an integral part of the construction of teacher-of-science identities. By conceptualizing this work as membership in two communities of practice, and studying how the going back-and-forth between these two communities throughout a school year enabled the positive construction of teacher-of-science identities, we come to appreciate the multiplicity of voices, length of time, and multiplicity of opportunities needed for such construction to take place.

NOTES

[1]   All student names are pseudonyms.

[2]   The symbol // indicates false starts or abandoned language replaced by new language.

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