Navigating Teacher Leadership through Vertical Teams

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Abstract

This paper presents findings from a multi-year study of a grant funded professional development fellowship program that supports teachers in becoming science teacher leaders and improving science curriculum and instruction. The program's activities are designed to: (1) create and support a corps of teacher leaders, (2) institute a culture reflective instruction, and (3) improve teacher quality through vertical articulation of curriculum and professional development. This paper shares the experiences of fellows in our third cohort during their first year in the program and focuses on their collaboration in a vertical group. Three significant themes emerged in the data: tendency to participate in a pseudo community (engaging in superficial conversation); focus on emerging problems of practice; and finally, interactions that encourage pulling back the curtain and reflecting on the details of practice.

Introduction

While the idea of teacher leadership is not new, there has been an increased scholarly and policy interest on building teacher leaders as change agents within their schools to address challenges including changing curricula, addressing the needs of diverse student populations, and committing to continual reform efforts. As central members of the school community, teachers play a unique role in helping colleagues initiate and sustain a community of learners and leaders to support such demands. Teachers have the potential to be leaders who can improve instructional practice in schools and impact student learning (Crowther, et al., 2002). Teacher leaders are teachers who lead within and beyond the classroom, contribute to a community of teachers, learners, and leaders, and influence other teachers toward improved educational practice (Katzenmeyer & Moller, 2001). They act as facilitators within the school, strengthening school reform and instructional improvement. There has been a rise in scholarship of the emergence of teacher leadership as a result of collaborative groups of teachers working to improve practice in response to reform efforts (Muijs & Harris, 2003; Murphy, 2005; Smylie et al., 2002; Welch, 2000). Having opportunities to make meaning for themselves, have ownership of their learning, and reflect on their practices has the potential to empower teachers as leaders (Katzenmeyer & Moller, 2001). In particular, there is an increased need for science teacher leaders in the United States, especially with the implementation of the Next Generation Science Standards (2014) as well the expanding emphasis that the nation places on a highly qualified science, technology, engineering, and mathematics (STEM) workforce.

Research studies show that teacher learning within a social context allows for a deeper understanding of the kinds of conditions needed to improve teacher practice (Cochran-Smith & Lytle, 1993; Lieberman & Wood, 2003; McLaughlin & Talbert, 2006; Wenger, 1998). In

particular, cultivating a common understanding shifts learning from a solely individual process to a social one that occurs through interactions and experiences. Fundamental to this idea of teacher learning is the notion that teachers learn collaboratively in communities and/or networks (Lieberman, 2000) where participants attempt to collaboratively construct meaningful knowledge in order to transform teaching and learning (Cochran-Smith & Lytle, 1999). For this to occur teacher learning must be conceptualized as a complex system rather than an isolated event (Clarke & Collins, 2007; Collins & Clarke, 2008; Hoban, 2002). Essentially, teacher learning has the potential to flourish when teachers feel a sense of belonging to a community and are contributors to that community.

As teachers transition into teacher leadership roles, they are positioned within both the leadership context and the teaching context (Cooper, Stanulis, Brondyk, Hamilton, Macaluso, & Meir, 2016). Empirical research about teacher leader preparation is limited but some have focused studies on programs designed to model instruction, empower teachers through collaboration, and support a process of shared inquiry (Caine & Caine, 2000; xxxx, xxxx, xxxx, xxxx, & xxxx, 2011).

This study focuses on five K-12 science teachers engaged in vertical articulation during their first year of a XXXX science teacher leadership fellowship program. Our program spans two years and is led in collaboration with university faculty and district coordinators from five participating school districts. During year one, teachers work in vertical teams (content-based) and then in horizontal teams (grade level-based) to study their practice through video. To set up their work, each team of five fellows chooses a teaching practice to study, selects and discusses a research article about that practice, and meets to provide feedback on every teacher's videoed lesson. The fellows follow protocols for pre and post-video debriefs and submit reflections forms

for each observed teacher. The entire cohort meets monthly with faculty in professional development workshops on such topics as backward design, classroom discourse, standards-based teaching, teacher leadership, and action research. The goal of the first year of the fellowship was to encourage reflective practice and collaborative work around a targeted specific scientific topic.

Specifically, we are examining a physics group made up of elementary, middle, and high school teachers. Using forms of energy as their physics topic, they explored the use of questioning in their lessons. They read and discussed the article titled "Question asking in the science classroom: Teacher attitudes and practices" (2014), developed and taught physics lessons focused on questioning techniques, videotaped lessons, and then analyzed and debriefed about each teacher's lesson during monthly meetings. These meetings involved conversations on teaching and learning across science content areas and grades levels.

In this study we engage in a micro-analysis of how these five fellows examine, analyze, and reflect on practice within their vertical team interactions. We explored how experience in this professional community of practice influenced their stance as reflective practitioners and teacher leaders. We asked:

1. What happens when science teacher leaders collaboratively examine their teacher practice in a vertical community of practice?
    a. What do we notice about how fellows engage in conversations around practice?
    b. What do notice about the way fellows examine and analyze teaching practices?

Literature Review and Theoretical Framework

Conceptualizing Teacher Leadership

Conceptualizing teacher leadership has been a challenge for researchers as the definition continues to evolve. Its imprecise definition reflects the ways in which teacher leaders construct their role in response to their context. The existing literature characterizes teacher leadership in terms of the behaviors and personal qualities demonstrated by teacher leaders; these qualities vary greatly among contexts and environments and many competing definitions of teacher leadership exist.

Collectively, the literature describes teacher leaders as educators who positively influence their peers by establishing and sustaining collegial relationships for the purpose of affecting change (Lieberman & Miller, 2005; York-Barr & Duke, 2004). Teacher leaders also possess a strong sense of purpose (Donaldson, 2007; Lambert, 2003), but they do not force colleagues to uphold the same values as they do (Frost & Durrant, 2003). Teacher leaders are willing to extend their work beyond their respective classrooms (Fullan & Hargreaves, 1996), and foster collegial interactions that focus on instructional strategies. Teacher leaders shine as risk takers and role models (The Center for Comprehensive School Reform and Improvement, 2005). As lifelong learners, they continually reflect and refine their practice. Finally, teacher leaders cultivate a positive school environment because they understand how the needs of their peers are impacted by the political factors of the school (Donaldson, 2007: Frost & Durrant, 2003).

Teacher Leader Collaboration

Teacher leadership involves collaborative efforts that seek to influence instructional practice. Because teacher leadership is not an individual action, they require a relationship between themselves and members of their school (Donaldson, 2007). Collaboration is one factor

that is important for teacher growth (Lucas & Valentine, 2002). Smylie et al. (2002) suggest that teachers have greater feelings of contributing to the school when they are engaged in collaboration. Through these collaborative interactions, teachers take on leadership roles and typically grow professionally as a result of their leadership. In contrast to the idea of collaboration, the nature of our educational system isolates teachers through most of their work (Donaldson, 2007; Robinson, 2009; Smylie 2010).

Collaboration is accepted as an important aspect of school improvement efforts (Goddard, Goddard, & Tschannen-Moran, 2007). When working in isolation teachers are less likely to exert effort outside of their classroom, and they typically avoid taking on leadership roles (Goddard et al., 2007; Mujis, 2010; Rogers, 2006). Collaboration encourages teachers to exercise leadership skills by sharing expertise, knowledge, and support (Goddard et al., 2007; Mujis, 2010; Smylie et al., 2002). Teachers who have experience, credibility, and expertise are sought after by other teachers for their help and guidance and through collaborative leadership, teachers can influence others informally (Donaldson, 2007; Rodgers, 2006; Smylie et al, 2002.).

Regardless of the varied teacher leadership structures established within schools, teachers need to recognize their ability to bring about change. Katzenmeyer and Moller (2001) acknowledge that teacher leadership is that it may not be for every teacher at all points in a career. There are times when participation may be inviting, and times when teachers may need to avoid extra responsibilities (Barth, 2001; Katzenmeyer & Moller 2001). As well, teacher leadership manifests differently depending on the actors and the current need of the school where the role is enacted.

Communities of Practice

To situate the professional development of teacher leader fellows within the context of their lived experiences, we drew on the literature from communities of practice (CoP) (Lave & Wenger, 1991). The CoP conceptual framework addresses how we manage the human and social aspects of knowledge creation and dissemination while improving human performance (Lave & Wenger 1991; Wenger 1998). CoP also offers a way to theorize tacit knowledge that is hard to communicate, something particularly of interest to the educational research community (Nonaka, 1994).

Brown and Duguid (2002), in their seminal text on CoPs, describe observations of Xerox repairmen, a study that would dramatically influence how work was organized there. They found that a top down view of the way the corporation worked did not explain the way employees were learning about their jobs and sharing information. Rather than seeking advice from superiors, Xerox repairmen looked to each other for help in understanding complex problems they encountered, problems not easily referenced in manuals, as "the information and training provided to the reps was inadequate for all but the most routine of the tasks they faced" (p. 100). There were few "predictable" problems that had easy solutions and instead they turned to each other for help: "For them, knowledge comes more from fellow practitioners than from cross-functional connections" (p. 97). The authors found the repairmen met frequently in informal ways and "posed questions, raised problems, offered solutions, constructed answers, and discussed changes in their work, the machines, or customer relations. In this way, both directly and indirectly, they kept one another up to date with what they knew, what they learned, and what they did" (p. 102). They argue that this sort of conversation "continuously but almost imperceptibly adjusts a group's collective knowledge and individual members' awareness of

each other" (p. 103). Seeley Brown and others refer to this kind of collaborative, group, knowledge building as a "community of practice" (Seashore Louis, Kruse, & Marks, 1996).

A CoP is a group of practitioners "who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger, et al., 2002, p. 4). Additionally, Wenger (2011) defines it as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (p. 1, http://hdl.handle.net/1794/11736). The three main characteristics of a CoP are: "a domain of knowledge, which defines a set of issues; a community of people who care about the domain; and the shared practice that they are developing to be effective in their domain" (Wenger, et al., 2002, p. 27).

Beyond work in corporations, building CoPs has evolved as a potential strategy to help teachers develop their content and pedagogical content knowledge (Borko, 2004). In an extensive study of the contexts of high school teaching, McLaughlin and Talbert (2001) write, "How high school teachers experience their careers depends a great deal upon the strength and character of their professional community" (p. 90). They suggest that looking at teacher communities is important for the what they might teach those interested in creating sustainable change.

Research on CoPs suggests that they are more likely to be "defined by loyal relationships and a stable social structure" (Grossman, Wineburg, & Woolworth, 2001, p. 945). The authors define a professional community as a group that share the following: a sense of identity and common values, role definitions, a common language, and the ability to reproduce the group through selection procedures and socialization processes. Seashore Louis, Kruse and Marks (1996) describe the elements of professional community as well as the cultural and structural

conditions that support it. They write that the elements that make up a professional community of teachers include: shared norms and values, a focus on student learning, reflective dialogue, deprivatization of practice, and collaboration. The cultural conditions that support professional community include a climate of professional inquiry, support for risk taking, and reshaping leadership at the school level and the structural conditions include size and complexity (the authors argue that it is more difficult to get teachers to talk to each other in larger schools), school autonomy and shared decision making, time for teacher planning and analysis, and professional development.

While not all forms of teacher community necessarily improve teaching and learning, there is some evidence that certain professional communities do make a significant impact on the work that teachers do and the experiences of students in the classroom ((Dunne, Nave, & Lewis, 2000; Hollins, McIntyre, DeBose, Hollins, & Towner, 2004; Lieberman & Mace, 2008; McDonald, 1996; Phillips, 2003; Strahan, 2003; Supovitz, 2002). Additionally, in his study of the Puente High School Professional Development program, Pradl (2002) notes that professional community building "dramatically changes how teachers think about teaching and learning" (p. 539). Borko (2004), found in a study of one professional development group, "Quantitative Understanding: Amplifying Student Achievement and Reasoning" or QUASAR, that professional learning communities had a significant role in "fostering teacher change and student learning" (p. 6). McLaughlin and Talbert's (2001) study of teacher professional communities differentiates between strong and weak professional communities. They define strong professional communities as groups "characterized by mutual engagement, joint enterprise, and shared repertoires of practice (such as materials and concepts)" (p. 127). Although most teachers are members of weak professional communities, the researchers do unearth a number of strong

professional communities. They find that strong professional communities tend to "establish distinctive expectations for teachers' work and interactions with students," (p. 10) although they caution that not all strong communities serve students well, as some can unfairly benefit certain students over others. Thus in an examination of strong professional communities it is important to look at both their quality and intentions.

The focus on professional community begs the "so what" question. Why does it matter if schools create strong professional CoPs? Wilson and Berne (1999) in their study on teacher learning and the acquisition of professional knowledge" discovered the "urge" for community: "In every case of teacher ongoing learning . . . teachers were engaged in learning communities that allowed them to test, discuss, revise, and retry their ideas about children's mathematical thinking and its relationship to instruction" (p. 183). The two most significant features of these communities were that they were self sustaining and focused on students' thinking. Grossman et al. (2001) argue that there are four reasons it is important to develop professional communities: 1) because they are a source of intellectual renewal, 2) they serve as a venue for new learning, 3) they are a venue for cultivating leadership, and 4) they believe it is good for students.

The role of relationship in professional community is a difficult one to assess and develop. Grossman, Wineburg, and Woolworth (2001), in their study of a group of English and Social Studies teachers working together, warn about the dangers of "pseudocommunity" believing that "individuals have a natural tendency to play community – to act as if they are already a community that shares values and common beliefs" (p. 955). People like to "behave as if we all agree" and people do this by "suppressing conflict" in order to preserve the "illusion of consensus". They also emphasize the role of relationships in communities noting that research on community suggests that they are more likely to be "defined by loyal relationships and a stable

social structure" (p. 945). The authors define professional community as a group that share the following: a sense of identity and common values, role definitions, a common language, and the ability to reproduce the group through selection procedures and socialization processes.

The CoP framework is instrumental in advancing understanding of how collaborative interactions in teachers' professional learning lead to organizational learning and change (Barab et al., 2002; Coburn & Stein, 2006; Levinson & Brantmeier, 2006); essentially it offers us a means of understanding the skills that teacher leaders engage in. The framework shifts attention from only focusing on individual learning to the learning of the individuals in a group, to the group's learning, and, in particular, to the outcomes of their collaborative interactions (Meirink et al., 2007; Stein et al., 1999). Essentially, the framework highlights how groups of educators work and, develop new practices together. We sought to specifically examine these features of teacher professional communities, described by Little (2003): Groups of teachers that 1. Come together to identify and examine problems of practice, 2. Explore the problem in collaboration with colleagues, seeking new answers and understandings to their concerns, 3. Have discussions around artifacts of classroom practice, and 4. "display dispositions, norms, and habits conducive to teacher learning and the improvement of teaching practice" (p. 938). We see this as essential to the kinds of work that help support and sustain teacher leadership.

This paper looks at the cross-school communities created by a grant funded program seeking to develop both content knowledge and pedagogical content knowledge. It examines the extent to which innovative professional communities are being built, and the impact these have on teachers' reflective practice. Particularly we looked at the following aspects of the work among these teachers: discussion around professional practice, collaborative problem solving, and critical reflection of teaching and learning.

Methods

This study used qualitative research methods to explore the dynamic and complex work of how science teacher leaders collectively influence practice (Merriam, 2009). We focused on the physics vertical group composed of five science teachers. By studying their interactions in vertical articulation meetings, learning through research, and practices of teacher leadership in situ, this study strove to uncover the dynamics of the fellows engaged in collaborative work.

Setting

This grant-funded professional development program in science teacher leadership, funded by a private corporation, is housed at a public state university in the Northeast. It is led by faculty in the college of education and in the college of science and mathematics. It is a two-year cohort experience in which fellows study their teaching practices collaboratively, implement an individual professional development plan, and design and facilitate professional development in their schools and districts. The funding supported three cohorts.

Participants

Five of the 20 members of the third cohort of the program were selected based on their reflections of the vertical team experience. Fellows were male and female, between the ages of 25 and 55, and with 3 – 20 years of teaching experience. There was 1 high school teacher, 2 middle school teachers and 2 elementary school teachers representing each of the five participating high needs school districts. The participants all were assigned their group based on content they taught, in this case physics/physical science. During the initial vertical team meeting, participants were given structured protocols to use during each of the mandatory vertical team meetings over the course of 5 months. All vertical groups used the same meeting

format dictated by the grant program. The group only had choice in the problem of practice and scientific topic they focused on in each lesson.

Data Sources

In accordance with qualitative methods, we collected the following data throughout the program.

Video artifacts of teaching. Each participant created a video artifact from a lesson taught. Additionally, all debrief sessions were videotaped. These transcribed videos focused on the fellows' teaching practices and interactions during debrief sessions and served as a means of checking teacher reflections on practice and analyzing group interactions.

Written Artifacts. Artifacts included: observation forms, video reflections, group presentation reflections and second year action plans.

Data Analysis

The constant-comparative method of qualitative data analysis (Glaser & Strauss, 1967) was used to code, sort, and categorize data, using both inductive and deductive methods of analysis. As a research group of faculty and four doctoral students, we began by individually reviewing the data; upon this initial review we decided to use a CoP framework for data analysis. We then created a protocol that used the CoP framework to again review data (see Appendix A). This first round specifically looked at the elements of a CoP described by Little (2003): identifying and examining problems of practice, exploring the problem in collaboration with colleagues and seeking new answers and understandings, discussing practice using classroom artifacts, and adhering to CoP norms. The research team collaboratively reviewed our individual responses to the protocol in order to develop the codes that formed our findings section. Upon returning to the data through the use of this framework for analysis, we discovered that it did not fully explain what we were reading. Thus we developed a deductive/inductive coding scheme

that included both elements of the COP framework as well as codes that emerged from our data sources. These included additional codes including: affirmation of practice (i.e. “that was a great lesson!”, organic problems of practice (separate from the originally defined problem the group started with), superficial observations of practice (“I liked the fact that you used technology”), pulling back the curtain of practice (when teachers talked through why they did what they did), pedagogical content knowledge, pedagogical knowledge, and vertical discussions (when teachers mentioned differences and similarities across grade levels). Later we collapsed a number of these codes into larger themes that we discuss below. They include: a tendency to participate in pseudo community, focusing on emergent problems of practice, and interactions leading to pulling back the curtain and reflecting on the details of practice.

Findings

Our data reveal three preliminary findings about the fellows’ engagement in the vertical team and how these influenced their reflective practice and their meaning making of their teaching.

Participating in a Pseudo Community

As noted in the literature about CoPs (Grossman et al, 2001), when fellows met in their vertical teams, they often struggled to engage in deep conversations about practice. We found a large percentage of talk (up to 1/3 in some debriefs) focused on what we think of as “superficial” discussions, which included generalized affirmations of what the other teachers did. For example, during the second debrief session, fellows commented on the teacher-student relationship observed during a middle school lab activity. One fellow noted, “I think you had a very good repertoire with your students. They were comfortable, you were comfortable . . . You still had command in terms of classroom management. I don’t think they would have done

anything to upset you." Another fellow added an artificial takeaway from the observed lesson, "I'm taking away the fact that you utilized the day before a holiday." We found continued examples of affirmations throughout the semester long debriefs. In the fourth debrief session two fellows' piggy-backed off one another reaffirming that the observed teacher was a master at questioning. The first fellow stated, "Watching you have those higher order questions, pushing them and trying out what we've been talking about in the meeting. That was great to see. That's when they're growing as learners, when they can't answer you." This was immediately followed by another fellow statement, "I actually think you're already quite skilled at student questioning in general. I think that XXXX was very on target with saying that you really made them think and you let them think." During the final debrief session, when asked how the lesson observed related to the research article on questioning, one fellow's response was:

> It was great. Um, the questioning, the prompting, your demeanor, the way you talk about it . . . I think you know, if every science lesson could be, could end like that it's golden. . . . I think you did a very good job. It ties in very well to the article. Your higher level for a second grader. Perfect!

The fellows' observations led to a proclamation of "great" teaching. This type of superficial feedback is unlikely to improve or challenge a teacher's practice, as it does not provide much analysis of why a particular aspect was effective. During the second debrief session the teacher whose practice was being analyzed responded, "Umm thank you, I agree with just about everything and umm pretty much everything." It was evident that she was agreeing with affirmative responses from her peers. Feedback such as this does not change the observed teacher's initial notions of what constitutes an analysis of practice, and the lack of concrete examples or other information does not help the teacher improve his or her practice. It is

interesting to note that faculty modeled a more critical kind of feedback in an early group session with fellows, offering alternatives for the kinds of talk that might be more productive. Despite this modeling, clearly fellows struggled to provide productive criticism consistently.

Fellows sought to make each other comfortable, emphasizing what they "liked" about each other classrooms and being excessively polite rather than providing more elaborate detailed observations of practice. Comments included, "I learned you have a really nice lab classroom. I'm jealous," "I really like this," or "the simulation program . . . really drew everyone's attention and they're actively thinking about the lesson." These three examples exemplify the kinds of discourse offered during the warm and cool feedback sessions. Fellows seemed to find it difficult to provide feedback with concrete evidence, which resulted in warm subjective comments about what struck them personally rather than fostering a sustained conversation about the teaching practice observed.

Finally, these superficial discussions often included commentary about off-topic comments related to less significant aspects of the videotaped lessons. For example, one fellow knowingly veered off topic, "I'm going to break protocol here for a sec, . . . when you're with the group, you have to be able to tune the rest of the class out. Because, at one point we heard metal hit the floor and it sounded like something broke and the teachers, most teachers' first response is 'Oh, what now?' But you completely tuned it out." Analyzing the content of this comment, it is apparent that the fellow was praising the teacher for not reacting to off task behaviors, but at the same time his feedback did little to support improvement in practice, especially addressing the identified problem of practice related to higher level questions. Similarly, in a separate debrief, a fellow mentioned an announcement that was made over the PA during the lesson, "I was listening to that [announcement], it kind of blew me away that they would think that it's

okay to make that kind of announcements to teachers . . . that's something . . . in my opinion to be addressed through an email." Another fellow followed up after a third interruption adding, "It was also slightly rude. I had a similar reaction when I heard that as well." Again this back and forth digression took the focus of the critical analysis away from the teacher's practice and to the uncontrollable things that happen in a classroom at any given time. We do not argue that such conversation is irrelevant to the work of teachers, but rather note that the amount and consistency of such talk illustrate the challenges of engaging in deep dialogue about the nuances and details of practice.

Although the fellows had some guidance in how to observe and give feedback about professional practice, they were not adequately prepared to engage in discussions that would change aspects of their practice. They struggled with providing specific feedback or asking probing questions that could extend or deepen reflection, something we see as central to their development as teacher leaders. Instead, they tended to focus on what happened in the classroom or what lessons they might take away from the experience. Even though we provided some structure through the use of protocols, these were not sufficient to create the kind of practice-based discourse for which we hoped. Visible in all debrief sessions, the superficial feedback always began with a general statement such as: "for warm feedback . . . I really liked when you called the students little scientists." These kinds of empty and generally ineffectual comments did not direct teachers to reflect upon central aspects of instruction or student engagement.

Emergent Problems of Practice

Before beginning work in their vertical collaborations, fellows were instructed to identify a problem of practice, find and read a research article about this, and plan lessons that might exemplify what they learned. The data pointed out that even more than talking about the

identified problem of practice, there was a disproportional amount of talk about what we call the "emergent problem of practice." By this we mean, extended talk about other problems of practice that emerged from their analysis of each other's videos. While these varied from debrief to debrief, for this particular group, these emergent problems of practice almost always centered around increased student engagement.

For example, during the debrief session of a high school physics lesson on energy, the fellows engaged in a lengthy discussion around student engagement, specifically describing elements of a successful student-centered lesson. One fellow began by elaborating on her observations/reflections during the lesson:

> I don't know if it's because you're obviously with 11th or 12th graders or your teaching style or the combination of it both. Your students were so comfortable to say, wait why? They didn't just take an answer at face value and they didn't turn to you, they turned to each other and they didn't wait to be called on by you, they just openly said, well this is what I think. And even when the students when up to the board to do the simulation, there's still that back chatter, but it was about their predictions. They were continuing that conversation of, no I don't think that was right, but I like what you said there. There was a lot of that open communication between you students and I think they were asking each other questions and it wasn't so teacher directed.

This immediately developed into an extended conversation around student interactions and engagement. Another fellow added, "A lot of the lesson was student kind of run, for lack of better term. They're the ones that were presenting, they were the ones that were manipulating the math… they asked each other for clarification." This discussion around the emergent problem of practice also challenged teachers to truly rethink their planning and purpose of various parts of

the lesson. One fellow questioned a teacher's choice of classroom setup, implying that it may inhibit student interaction and engagement, "I almost feel like your seating arrangement didn't benefit them . . . I almost feel like a U-shape . . . because they are asking really important questions." This led another fellow who initially did not have feedback on student engagement to add, "Even though they were all engaged . . . it would have been a great idea if the seating arrangement would have them literally turn to each other." This type of discussion was not unique to the upper grade lessons, it was just as evident in the analysis of a second-grade science lesson. One fellow was amazed at the level of engagement of the second graders, "I was like amazed because that kind of group . . . they started engaged . . . after that I felt like they were really engaged." Another added, "You had a different environment and it allowed them [students] to really be engaged, get their sillies out um, I think that's really important in second grade." In this example, the discussion about the pedagogical challenge of engaging students led fellows to analyze and question their colleagues about the choices they made in carrying out the lesson. For example, a fellow posed a question about student engagement to the group: "The students were so engaged like most of the time you were staying back . . . there was a very good connection. So how do you develop those kinds of connections?" This led to some reflection on the part of the teacher about how he was navigating this challenge. He finally added, "I was tough in the beginning and it paid off . . . just trying to find out ways to use the energy they bring to class every day in a positive way." When the fellows focused the discussion on student engagement, the emergent problem of practice, the analysis of lessons expanded the fellows' vision of what criteria to consider when determining features of instruction that might constrain or support student learning and engagement. Student engagement functioned as the contextual

anchor that grounded the conversations about teaching and learning in concrete relevant examples and thus made those conversations more focused and productive.

When the feedback became focused on instruction and student engagement, the emergent problem of practice, the fellows grew confident in engaging in extended discussion around professional practice. One fellow mused about how to extend what they were doing in a future lesson, "I was thinking maybe the students share their ideas with other students, so they come to the front and speak about what they did." As the fellows engaged in these discussions, they developed their knowledge and skills about facilitating instructional practice, something key to their role as teacher leaders within their schools.

In all of these examples, when fellows reflected on their practice, they were able to specifically identify aspects of instruction and student engagement that may be fruitful for others to notice in their own classroom. Ultimately, the fellows' co-constructed knowledge about teaching had the potential to be integrated into their practice. Similarly, guiding fellows to reflect on examples of instruction with their peers has the potential to improve their ability to notice consequential aspects of their facilitation of student engagement.

Pulling Back the Curtain/Reflection on practice

Our data revealed that when fellows met to discuss and debrief video of practice, their peers' questions and observations led them to engage in extended reflection about the thinking behind their practice. Often this took the form of talk about planning and organization, exploring why they made particular choices of instructional strategies, and describing what their expectations were of their students. One fellow reflected on how she grouped her students in this particular lesson and how she might group them differently in the future, "I would group students differently next time, more heterogeneously. One group was giving very basic answers, 'this is

what I saw'" or "this is what happened . . . I have not mastered how to group my students." Another shared, "I feel like I don't know why I didn't think of it before? I model everything else." Fellows utilized the vertical team meetings as opportunities to reflect on and broaden their teaching practices. One teacher said, "So I learned that you have to be well-orchestrated especially with the . . . student population that you have. I am taking notes down for my next investigation to make sure that it is organized." The discussion on grouping or practical strategies for note-taking are important in terms of analyzing one's practice. It seems that through this type of uncovering, the fellows truly began to see reason or affirmation for the instructional choices they made.

Varying parts of the debrief discussions dug deeper into a teacher's purposeful planning or instructional choices. When asked by a fellow if conferencing with students is a routine activity, the teacher responded: "I've been experimenting on that. . . I started it last year and I do that for science particularly. One, because when I give them a worksheet, they don't all fill it out. At the end when it's time for me to grade it, most half of them is blank. I try to go back and conference with them." By removing the initial layer of conferencing with students, this teacher moved to question her own choice of grouping. Essentially, through back and forth questions posed by the group, the teacher determined that to effectively reach all the students in this class through experimentation and conferencing, the grouping must be changed. She reflected,

> The thing that I wish I had done differently was grouping . . . There were two groups that really could not understand what's going on. They're giving me plain and simple, "this is what I saw," and "this is what happened" and they cannot think deeper into what the concept is. That's when I combined . . . I think you saw in one of the conferences, the two groups got combined together. They're all girls. They were the ones that were trying to

> figure out how to put the spool racer back together. One group really did not have, in terms of their level, [she] really needed another student to be with her to start off the discussion further than what we saw.

In a similar example, one fellow questioned a teacher about the use of marbles for a particular energy experiment. The teacher's response was, "The marble I chose is a nice shooter and it . . . gets a good bounce. Bouncy balls have too much [bounce] and then they are all over the classroom. But the glass marble . . . works." This teacher's reflection became more substantial when she explained the use of different materials and its connection to Newton laws. Through extended discussion, fellows began to unpack their planning and instructional decisions. Similarly, when trying to relate to the designated problem of practice, questioning, the second-grade teacher reflected on his challenges:

> Yeah, so its uh, this is tough to tie, this kind of assessment . . . you have to understand before they write words on paper they have to sketch and illustrate. First, they have to sketch it in planning boxes . . . so to ask them to write words now and explain their thinking that's tough . . . [holds student sample up to camera]. I wish there was something deeper there but um, but you know as an observer what does the student work tell me? It tells me they're trying . . . they're doing their best right now, they have limited vocabulary still in second grade but you can see the effort . . . and those that had to record wrote words if they could.

Research suggests that engaging in self-reflection can help all teachers improve their practice, regardless of their experiences or dispositions (Larrivee, 2008; Walkington, 2005). There is some evidence that a lack of time to collaborate in meaningful or sustained ways may prevent many teachers from being able to engage in this process of self-reflection. Through their roles as

teacher leaders, they may be able to engage in the kind of meaningful and sustained collaboration that can lead to self-reflection and continuous improvement (Richie, 2013).

Conclusion

As highlighted in the literature, teacher leaders have substantial teaching experience and the potential to influence and contribute to their colleagues' professional practice to continuously improve educational practices (Katzenmeyer & Moller, 2001; Roby, 2009; York-Barr & Duke 2004). While a teacher leader needs to excel in his or her own teaching role, researchers have found that strong teaching practice alone is not sufficient to make a teacher leader. This is the distinguishing factor between a teacher leader and an expert teacher. Being a teacher leader entails the increased responsibilities of engaging in discussion around professional practice beyond the classroom (Ryder, 2013).

The CoP framework helped reveal to us the importance of an organic community of practice. Providing set vertical teams, structured protocols, and the invitation to identify a problem of practice prior to teaching limited the fellows' ability to make substantial meaning of the work they were doing within the vertical teams. To be an effective teacher leader and critical friend, fellows must be able to engage in authentic discussions around practice.

We have argued that part of what the science fellows need to develop as teacher leaders within and beyond their classrooms is the ability to reason, reflect, and critically analyze professional practice, and to make well-informed instructional decisions. In essence, the purpose of engaging the fellows in vertical articulation within the CoP was to enhance their abilities as reflective practitioners and peer coaches to view classroom practice through a thoughtful analytical lens. Science teacher leaders should be recognized as partners in instructional change,

but to do that they need to be able to examine practice and provide feedback that extends and improves teaching.

This study offers insight into how to support teachers in becoming teacher leaders who can engage in discussions around professional practices. Analysis of vertical team conversations suggest that teacher leaders need professional development and guidance about how to critically analyze teacher practice and provide meaningful feedback. We believe that our study's implications also provide insights into how universities and professional development programs can foster collaboration in vertical teams and address the needs of developing teacher leaders as they engage in leadership activities.

Through the use of a CoP framework, we have begun to realize that the professional work that occurs in a prescriptive CoP with defined structural components reveal a pattern of superficial meaning making around professional practice. As the fellows engaged in the collaborative sessions, their actions were driven by task accomplishment around the structured protocols. To examine teacher leaders' work in vertical teams, it is more useful to use an authentic approach to CoPs, where members who have common interests have opportunities to examine practice through questions that emerge from their classroom teaching (Printy, 2008). This might still involve a protocol to support teachers in identifying a problem of practice, but their focus would emerge from the videoed lessons, rather than a predetermined lens. As described by Wenger (1998) CoPs exist because its members have common understanding and knowledge to share with one another. The social relations between members in CoPs place our fellows as informal leaders who help shape social relations among members to facilitate learning (Wenger, 2000). Leadership within the community is emergent and distributed among others outside (McLaughlin & Talbert, 2001; Ogawa & Bossert, 1995; Pounder, Ogawa, & Adams,

1995; Spillane, Halverson, & Diamond, 2001). The pseudo communities that we described diminish the stature of teachers and constrain the emergence of their leadership; thus we have begun to think about how teacher leaders can foster emergent and natural CoPs. Teachers are more likely to incorporate learning into their own practice that occurs in a CoP with which they identify and in which they are fully invested. Like the Xerox workers, when the problems were authentic, the discussion was extended and analytical. In essence, teacher's communities emerge where they feel included and vested in the work they deem important.

These findings have important implications for our program as well the ways in which our program fosters teacher leadership. We realize now that the forced structures we have put in place for our fellow teachers limit and constrain their potential to examine authentic emergent questions and extend and deepen their critical reflection of their teaching. We have begun to question whether the superficial nature of the interactions would lessen over time as the group begun to set their own norms and establish trust among its members. We realize we need to create additional sustained and supportive opportunities to model what teaching and learning should look like in collaborative settings. To make a significant impact, we need to better model the analytical process as well as begin to think of ways the fellows can have ownership of establishing their community. We believe that the structured protocols should be provided as a basis for modeling, but that each community must develop their own protocols that are context specific for their intended goals, since what works for one group may not work with another group of fellows.

When community members identify a problem of practice, which the group considers a shared challenge that has been difficult to address alone, they create a common purpose for opening their doors together for deep collaborative work (Keay, May, & O'Mahoney, 2014). The

emergent secondary problems of practice fellows identified remind us that selecting a problem of practice is not *our* goal, rather being able to address tangible relevant questions that emerge from the classroom is. It appears that having the fellows identify a problem of practice prior to examining practice was not a powerful catalyst for change.

Little research exists on how work in content based learning communities supports or inhibits emerging teacher leadership. This study contributes to the teacher leadership literature by helping to identify a connection between teacher leadership, professional development, and communities of practice. It provides practitioners and policy makers with a model for content-based vertical collaboration that enhances teacher learning. Attention also needs to be paid to creating school cultures that embrace teacher leaders' interactions with a whole continuum of individuals and this may illuminate strategies for how to do this. We believe our fellowship program has the potential to address this through supporting peer interactions that supports science teacher leaders with teachers, administrators, and district coordinators.

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