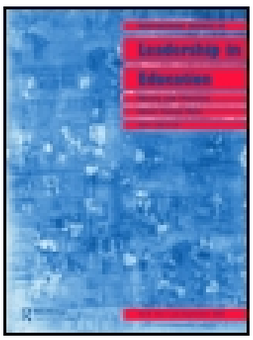

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ARTICLE

Professional development for teacher leaders: using activity theory to understand the complexities of sustainable change

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ABSTRACT

This article presents findings from a two-year, qualitative study of K-12 teacher Fellows involved in a grant-funded professional development program. Aiming to foster sustainable change in districts and support emergent teacher leadership, the program enabled Fellows to collaboratively reflect on practice and develop as teacher leaders who lead informally from the classroom. Using activity theory as an analytical lens, the following main themes emerged in the data: (1) Teacher leaders have complex definitions of teacher leadership that parallel teaching beliefs; (2) Teacher leaders need strong communication skills to collaborate within different contexts; (3) Teacher leaders benefit from work on vertical articulation; and (4) School culture and administrative support influences teacher leadership. We explore the implications for professional development programs in districts, and in particular, those that address the need to cultivate teacher leadership.

The context of the work of teachers continues to change (Bales, 2006; Hatch, White, & Faigenbaum, 2005) as they face unprecedented challenges and have to navigate policy directives that link their professional growth to student learning in their classrooms (Darling-Hammond, 2000; Datnow, Hubbard, & Mehan, 2002; Fishman, Marx, Best, & Tal, 2003; Spillane, 1999). In the U.S.A, for example, the No Child Left Behind Act equated teacher effectiveness with high-stakes testing of students (McLaughlin & Talbert, 2006). More recently, in 2015, the Every Student Succeeds Act (ESSA) proposed that professional development for teachers be evidence based and designed in response to their students' test results (Education Week, 2016). These policies as well as increased public scrutiny, deep fiscal problems and ineffective highly bureaucratic administrations create an environment where teachers question their worth in schools, do not feel job satisfaction and are generally under tremendous stress (Flook, Goldberg, Pinger, Bonus, & Davidson, 2013: Johnson,

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Kraft, & Papay, 2012; Margolis, 2008). Additionally, teachers remain in static school cultures (Kennedy, 2005; Opfer & Pedder, 2011; Stigler & Hiebert, 1999) where high-stakes testing is ever-present and professional development is facilitated by outside consultants with pre-packaged programs (Cochran-Smith & Lytle, 2009; Lieberman & Miller, 2011; Talbert, 2010). Their school environments make teacher leadership an impossibility as teachers feel overburdened with minute responsibilities. However, contrary to the rationale of policymakers to increase high-stakes testing as a means of increasing student achievement, a report commissioned and published by the Wallace Foundation (Leithwood, Seashore, Anderson, & Walshtrom, 2004) found a direct relationship between strong teacher leadership and increased student achievement, supporting the idea that teacher leadership may be a promising way to cultivate teachers to become leaders aimed at improving instructional practice in schools, with the potential to impact student learning (Crowther, Kaagen, Ferguson, & Hann, 2002).

This article presents findings from a two-year, qualitative study of K-12 science teachers involved in the Wipro Science Education Fellowship program, funded by Wipro, a global information technology and consulting corporation. Aiming to foster sustainable change in districts and support emergent teacher leadership, the program enabled Fellows to collaboratively reflect on practice and develop as teacher leaders who lead informally from the classroom. To become teacher leaders, these Fellows assumed a learning orientation toward their daily work (York-Barr & Duke, 2004), and problematized their teaching as active learners (Cochran-Smith & Lytle, 2009; Grossman et al., 2009; Opfer & Pedder, 2011). Constructing knowledge, having ownership of their learning and contributing to a larger professional community all potentially contributed to their teacher leadership.

The Wipro SEF program spanned two years and was led in collaboration with district coordinators from five participating school districts. During year one, Fellows worked in vertical teams (content-based) and then in horizontal teams (grade level-based) to study their practice through video. To setup their work, each team of five Fellows chose a teaching practice to study, selected and discussed a research article about that practice and provided feedback on every teacher's videoed lesson. The Fellows followed protocols for pre- and post-video debriefs and submitted reflections for each observed teacher. The entire cohort met monthly with faculty in professional development workshops on such topics as backward design, classroom discourse, standards-based teaching, teacher leadership and action research.

In year two, Fellows designed and implemented a teacher leadership plan (a growth plan system) in their district with support from university faculty and district mentors. They delved deeply into their inquiries and expanded their spheres of influence to lead professional development in their grades, schools and districts through conducting action research, facilitating teacher study groups, mentoring and coaching teachers, writing articles, presenting at conferences, running workshops or developing curricula.

In this study, we sought to understand how Fellows developed as teacher leaders through their participation in the program and their actions in their schools and districts. Our specific questions became:

- How did Fellows define teacher leadership over the course of the program?
- What skills and strategies did they identify as necessary for teacher leadership?
- How did the program nurture the Fellows as teacher leaders?

- What structures or school environments did they identify as supporting or hindering their ability to take up those actions?

In this article, we begin with a discussion of the teacher leadership literature in order to contextualize the study. Next, we explain our rationale for using activity theory as our conceptual analytical lens to complicate our findings and discover their nuances. We then present our participants, data methods, analysis and findings as well as our recommendations for future work in fostering change through teacher leadership.

Teacher leadership

York-Barr and Duke (2004) suggested that teacher leadership is the process by which classroom teachers, individually or collectively, influence their colleagues, principals and other members of the school community to improve teaching and learning practices. In a recent paper from the Aspen Institute, Curtis (2013) defined teacher leadership as 'specific roles and responsibilities that recognize the talents of the most effective teachers and deploy them in the service of student learning, adult learning and collaboration, and school and system improvement' (p. 4). Additionally, Curtis (2013) called teacher leaders 'innovators, researchers, champions of student learning, leaders of colleagues, and policy advocates' (p. 4). Classroom teachers come to view leadership as part of their professional role, sharing and enhancing professional learning within their school setting. They generate new knowledge for themselves from action (Reason & Bradbury, 2008) which leads to new initiatives (Taylor, Goeke, Klein, Onore, & Geist, 2011) that affect change in their classrooms, schools and communities (Onore, Goeke, Taylor, & Klein, 2009). Impacting the school beyond their own classrooms involves: improving practice and deepening content knowledge, mentoring, developing curriculum, nurturing professional communities, participating in school decision-making, fostering change and challenging the status quo (Danielson, 2006; Fairman & Mackenzie, 2012; Jacobs, Beck, & Crowell, 2014; Silva, Gimbert, & Nolan, 2000; Stone & Cuper, 2006).

Because of the complexity of teacher leadership, its definition is often dynamic, fluid and multiple. Muijs and Harris (2006) echoed this perspective when they wrote: 'Leadership is a fluid and emergent rather than a fixed phenomenon' (p. 962). Teacher leadership can emerge at the individual level, in collaboration with others, and within larger organizations (Taylor, Goeke, Klein, Onore, & Geist, 2011). Being a teacher leader involves formal and informal ways to improve instruction, learning, and school and classroom culture and these vary across contexts, expectations and organizational structures (Fairman & Mackenzie, 2012; Mentzer, Czerniak, & Struble, 2014; Muijs & Harris, 2006; York-Barr & Duke, 2004). Formal or informal impact could manifest as a result of an individual teacher leader or the distributed leadership within an organization (Gigante & Firestone, 2008; Ritchie, 2012; Ritchie, Tobin, Roth, & Carambo, 2007). From the latter perspective with a focus on the relational (Donaldson, 2006; Muijs & Harris, 2006), systemic change through teacher leadership can be explored across a school or district with attention given to trusting and non-hierarchical relationships and interactions among administrators, teachers and students. Building these types of relationships where power is shared rather than allocated involves creating mechanisms for democratic decision-making and negotiation of roles and responsibilities. When teacher leaders are involved in decision-making (Muijs & Harris,

2007), they feel more supported in their leadership initiatives, more effective in achieving systemic change, more connected to other teachers through networking opportunities (Taylor, Yates, Meyer, & Kinsella, 2011) and more empowered, motivated and committed to remaining a teacher (Muijs & Harris, 2006; Taylor, Yates, Meyer, & Kinsella, 2011).

According to the literature, teacher leaders are most effective when their principal relies on them to achieve the larger goals and objectives of the school and actively scaffolds and supports their transition into becoming teacher leaders (Weiner, 2011). Thus, in order for a shift in leadership structure to occur at a school, focus cannot solely be on an individual leader. Instead, an examination of the interactions between those in leadership roles, rather than their actions, needs to occur. Teacher leadership is the most impactful when a distributed leadership model is used which examines the work of teachers, teacher leaders, administrators and others, in order to support a range of educational leadership types and school reform (Gronn, 2000; Harris, 2008, 2010; Harris, Leithwood, Day, Sammons, & Hopkins, 2007; Mayrowetz, 2008; Spillane, 2005; Spillane, Halverson, & Diamond, 2004).

Distributed leadership in schools has the potential to be relational, fluid and multi-directional actions that empower multiple stakeholders in schools. Gronn (2000) contended that 'leadership needs to be distributed throughout the organization and not just assigned to fixed positions' (p. 333) like administrators. Spillane, Halverson, and Diamond (2001) reminded us that leadership happens in a variety of ways throughout a school and is centered on interactions between people 'depending on the particular leadership task, school leaders' knowledge and expertise may be best explored at the group or collective level rather than at the individual leader's level' (p. 25).

Our study helped us realize the complexities and nuances of nurturing teacher leaders in order to promote sustainable school change. As Spillane et al. (2001) emphasized above, we hoped to examine the interactions of our teacher leaders at the individual, collaborative and school organization levels and take account of with whom they worked as well as what contextual factors impacted their influence. Examining distributed leadership led us to think about using the activity theory framework as an analytical lens for our data. We believe that without the use of activity theory, the findings would appear simplistic and predictable. Using activity theory reminded us of the messiness of enacting sustainable change and the obstacles that emerge when certain variables are absent from this work. Below we explain activity theory in relationship to our teacher leadership study.

Activity theory

Adding to the theoretical underpinnings informing the current study, we focused on the sociocultural notion that 'defines human learning as a dynamic social activity that is situated in physical and social contexts, and distributed across persons, tools, and activities' (Johnson, 2006, p. 237) and is essentially contextualized within the theoretical parameters of activity theory (Engeström, Miettinen, & Punamäki, 1999; Leontiev, 1978). Activity theory (Engeström, 1999; Engeström et al., 1999; Kaptelinin & Nardi, 2006) is an appropriate theoretical lens to analyze the guiding questions for this study because it enables the analysis of the myriad of actions performed by teacher leaders during their leadership activities. Many scholars argue that activity theory is not a 'theory' in a strict interpretation of the term, but a conceptual framework offering a set of principles for generating more specific theories (Kaptelinin & Nardi, 2006; Kuutti, 1996). There are two fundamental

concepts that underpin activity theory: one is that knowledge is mediated through tools and artifacts, and the other is that human activity is the fundamental unit of analysis (Engeström et al., 1999).

In recent years, Engeström (1999) created a complex model of an activity system, yet this theory has its primary roots in Marxism and aims at describing actions and interactions in social settings. Aligned with Marxist beliefs, activity theory first shows a link between the individual subject and objective societal structures, as a way for understanding and interpreting change. Building upon this, activity theory has its historical foundations in the sociocultural and social cognition work of Russian psychologists Vygotsky, Leont'ev, and Luria (Engeström et al., 1999). Engeström (1999) describes the evolution of activity theory through several generations, all of which focus on the connections between situated knowing and doing. The version drawn upon in this study, referred to as the second generation, describes the social influences and interdependencies in a complex web of human activity. Depicted below in the triangular model in Figure 1, an activity system is comprised of seven interacting elements including the object, outcome, subject, tools, rules, community and division of labor.

In an activity system, the ultimate aim is to reach an *outcome*, which can only be achieved by co-constructing certain *objects* shaped by a number of *tools or mediating artifacts*. The *subject* is the individual or group aiming to achieve the *object*. The object can be considered as the objective – that is, what is the subject trying to achieve? For example, if we considered a teacher (subject) in a school setting, the tools would be the teacher's instructional resources and the teacher's objective could be focused on developing an innovative constructivist-based unit. When the subject engages in an activity, there exists a set of rules (implicit or explicit) that influence how the activity occurs. The activity is also influenced by the community, which interacts with the subject. The *community* refers to a group of individuals or organization mediated by a general shared *object*. The subject(s) and the activity are also influenced by the *division of labor*, which determines how the work load is handled. This division of labor refers to both the horizontal division of task among members of the community and to the vertical division of power and status. Continuing

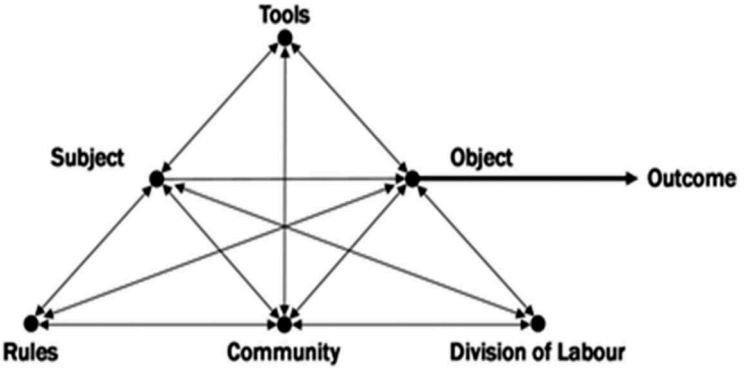

Figure 1. Activity system. Adapted from Daniels, H., Guiterrez, K. D., & Sannino, A. (2009). Learning and expanding with activity theory (p. 89), York, England: Cambridge University Press. Adapted with permission.

with the earlier example, the teacher must mediate between resources available to her, be mindful of the district curriculum (rules), recognize the influence and demands of the school community with regard to the appropriateness and support of developing the unit, and finally, decide the unit of study being developed with grade- or department-level colleagues (division of labor). Rules, community and division of labor are the social basis of the activity, which provide the context, influence the subject and shape the activity (Engeström et al., 1999; Yamagata-Lynch, 2010).

The aforementioned components in an activity system are not static nor do they exist in isolation from each other. The interplay between elements, as represented by the arrows in Figure 1, captures these reciprocal relationships that can provide opportunities for change. A researcher may find a 'breakdown' in a reciprocal relationship, represented by a dashed arrow. These are considered 'contradictions' (Russell & Schneiderheinze, 2005) or sites of tension that allow shifts to occur in the system as mediated by the subject, object, and/or artifacts and tools. Engeström and his colleagues argued that the constant change and movement within the system acts to bring about expansive learning. Therefore, an examination of any phenomenon using activity theory as an analytical lens necessitates a diligent examination of the dynamic nature of and interrelations among these components.

In our research, we used activity theory to analyze how our Fellows took up identities as teacher leaders. The six elements of the activity structure helped us to understand the process of emergent teacher leadership within our program. Fellows (science teacher participants) were the subject, teacher leadership the object and distributed leadership the intended outcome. The linear path was mediated through tools, rules, community and the division of labor. These elements played a dynamic role in Fellows engaging in actions that were directed toward their own object or goals in order for them to construct their own meaning of teacher leadership, and eventually, enact change in their schools. The community in this model referred to the different subgroups of individuals who participated and interacted with the Fellows. For example, the horizontal group of the Fellow established one community, while the vertical group could be considered another. Fellows could be engaged in several different communities where interactions between themselves, their peers and other elements played a role in determining the pathway toward their development as teacher leaders and ultimately toward promoting change. Another dimension to this activity system was the division of labor, which for our purposes was composed of district coordinators, district administrators, Fellows and other teachers. In our activity system, the rules and conventions were inductively identified by the voices of teacher leaders and district coordinators during the monthly meetings. The activity systems were dynamic and were constantly disrupted by the interactions between the various components. Engeström (1999) referred to these disturbances as deviations, specifically the tensions between the Fellow, her development as a teacher leader and communities to which she belonged that supported the transformation. These tensions essentially became the driving force to help transform the overall system. Much of the work in teacher leadership has been under theorized, and we believe that using activity theory as an analytical lens revealed some of the nuances of becoming a teacher leader as well as some of the constraints that emerge through the teacher leadership activities.

Methods

This study used qualitative research methods to explore the dynamic and complex work of becoming a teacher leader (Merriam, 2009). We took a phenomenological approach to understanding the beliefs, intentions, knowledge and actions of participants related to teacher leadership. By studying their initial and emerging beliefs as well as their learning through research and their teacher leadership practices *in situ* and examining these through an activity theory lens, this study was able to uncover the dynamics of the praxis of the participants as they became teacher leaders.

Setting and Participants

This grant-funded professional development program in science teacher leadership was housed at a U.S. Northeastern public state university. It was led collaboratively by faculty in the College of Education and the College of Science and Mathematics and in partnership with five local school districts. Each school district comprised high-needs schools and represented diverse student populations. In order to underscore the importance of district-level participation and teachers' ownership of the program, most of the monthly workshops were held in the districts.

Eight out of 20 members of the first cohort of the program agreed to participate in the study. A prerequisite for admission was at least three years of teaching experience. Fellows were male and female, between the ages of 25 and 55, and with 3–30 years of teaching experience. There were four high school teachers (Anna, Jill, Oscar, Pat) and four middle school teachers (Beth, Sue, Miranda, Doug) from four out of five of the participating school districts. None of the elementary school teachers chose to participate in the study. We believe this is because science is only one content of several that they teach each day and is not their primary focus of instruction. Fellows that did agree to participate in the study consented to being interviewed and also allowed us to analyze all reflections and artifacts.

Data Collection and Analysis

For this study, we primarily examined transcripts from interviews with the Fellows. Fellows were interviewed three times over the course of two years: at the beginning of the program, and at the end of the first year and at the end of the second year of the program. Semi-structured interviews, lasting approximately 1 hour, were conducted and transcribed.

In addition, we collected the following artifacts as secondary data: (a) admissions data including essays about their ideas about teacher leadership; (b) team protocols of pre-observation forms, notes about video reflections and post-observation notes; (c) field notes from semi-annual group presentations; and (d) their second-year teacher leadership action plans and reflections. Each participant created two video artifacts: one conducted for the vertical team and the other for the horizontal team. These videos were filmed focused on the teaching of the Fellows and served as a means of checking teacher reflections on practice. Although these artifacts were secondary data to the interview transcripts, they did serve as a means of triangulating the findings that emerged.

The constant-comparative method of qualitative data analysis (Glaser & Strauss, 1967) was used to code, sort and categorize data. The six members of the research team began by individually identifying themes and their examples. We engaged in emergent coding related to our research questions; researchers developed codes to reflect the different definitions of teacher leadership, the actions Fellows took up in relation to the program and the structures they indicated as supports and hindrances. We shared our patterns through an excel spreadsheet on google docs and then met as a group to discuss our proposed codes. We collectively clarified and generated hierarchies of codes, triangulating the categories of each individual researcher, looking for patterns and consistencies. Initially, our themes were quite superficial and represented very generalized overarching ideas. These included: (1) Definitions of teacher leadership; (2) The relational aspects of teacher leadership; and (3) District constraints to teacher leadership. We then returned to the data and look across multiple sources beyond the interview transcripts to triangulate the codes that emerged. This led us to deepen and expand our findings to the following: (1) Teacher leaders have complex definitions of teacher leadership that parallel teaching beliefs; (2) Teacher leaders need strong communication skills to collaborate within different contexts; (3) Teacher leaders benefit from work on vertical articulation; and (4) School culture and administrative support influences teacher leadership. Realizing that some of these findings might seem obvious, we began to brainstorm ways to problematize them. Examining the literature, we came upon activity theory and used it as an analytical lens to see the complexities and nuances of these findings. Finally, from there, we developed interpretations across categories and verified the findings.

We used triangulation as well as member checking as a means to ensure trustworthiness and credibility. For example, we triangulated the interview data in two ways: first, we examined all interview transcripts of each individual participant for patterns or themes; and then we looked across the eight interview sets to see whether those findings were consistently present. Additionally, we invited the participants to take a look at the themes and clarify whether or not they represented their thinking at the time of the interview and if there were any missing pieces of information.

Findings

In this section, we present the findings of our study through the lens of activity theory, specifically articulating the relationship of Fellows in their development as teacher leaders to corresponding components of the systems of their schools. Our data revealed four significant findings related to teacher leadership. Within all our findings, the intended pathway for the activity system can be seen in Figure 2:

Figure 2. Activity Pathway. Adapted from Daniels, H., Guiterrez, K. D., & Sannino, A. (2009). Learning and expanding with activity theory (p. 89), York, England: Cambridge University Press. Adapted with permission.

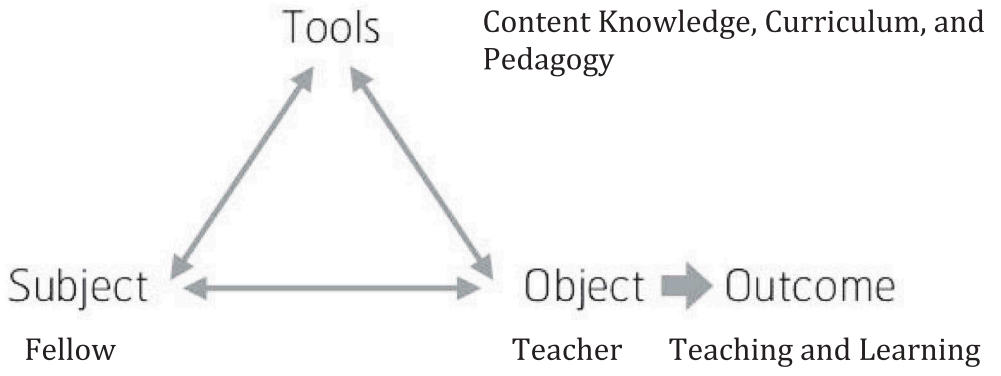

Figure 3. Activity System for Science Teacher Leaders. Adapted from Daniels, H., Guiterrez, K. D., & Sannino, A. (2009). Learning and expanding with activity theory (p. 89), York, England: Cambridge University Press. Adapted with permission.

Teacher leaders have complex definitions of teacher leadership that parallel teaching beliefs

Figure 3 is a graphic representation of the ways in which we use *subjects, tools, objects and outcomes* as activity system components to describe this finding.

In this section, using activity theory to analyze Fellows' conceptualizations of teacher leadership in response to our first research question unearthed two primary definitions: teacher leader as content knowledge expert and teacher leader as co-constructor of knowledge. Applying activity theory, we show how individual definitions formulated by Fellows are linked to their specific teaching beliefs. By viewing Fellows as the *subjects* in Engeström's model, we found that their definition of teacher leadership impacted the *tools* they chose to use in order to obtain the *object, teacher leadership* and ultimately their *outcome, change in schools*. Those that conceptualized teacher leaders as teaching experts who convey information directly and model what teachers ought to do, relied on tools such as pedagogical content knowledge, curriculum and instructional techniques in order to act as teacher leaders. Their pathways involved direct instruction or transmission. For example, Oscar explained how teacher leadership involved being an expert in content knowledge:

> It would be cool to be able to be like the person, 'Oh, I'm having a hard time teaching density, Can you help me?' And being like, 'Yes! I have this great thing we can do. Let's go!'… Kind of like a super-hero. (Interview 2, January)

Oscar (the subject of the activity) saw his teacher leader role as a knowledge transmitter who used the tools of pedagogical content knowledge and instructional practices to promote change. Similarly, other Fellows emphasized the need for teacher leaders to be knowledge providers. Miranda stated, 'It is somebody whose full-time focus is in topnotch pedagogy', while Doug adds:

> being … in charge of stuff … more because you are competent about it and you know you have that knowledge and you know that you are going to be able to give that knowledge to someone else. (Interview 3, August)

In contrast, some Fellows viewed teacher leadership as a more democratic role, where the teacher leader (subject) facilitated professional learning of other teachers through a constructivist approach. Similar to above, the tools utilized by these Fellows are also pedagogical content knowledge, curriculum and instructional techniques, yet the pathway to teacher leadership, the object or change in schools, the outcome, was very different. For instance, Doug who described science learning as a student-centered process had the following vision of teacher leadership:

> A science teacher leader is someone who is a resource for other teachers that they have someone to go to ask as a guide for questions, when they want to find new ways. It's not a supervisor. It's almost like a mentor role. You know you understand what you are doing and others can learn from you without it being a formal process. (Interview 2, January)

From this perspective, teacher leadership is about learning alongside one another by doing, by engaging in a collective activity that involves teachers engaging in hands on experiences through the guidance of facilitators. This view of teacher leadership resonated with Patric, who emphasized the need for teacher leaders to 'encourage growth within their district by adding and by sharing innovation and encouragement with other teachers' (Interview 3, August). He compared teacher leadership to the ways in which he approached his students in the classroom.

Using activity theory as an analytical lens reminded us that even those Fellows who saw their leadership as a collaborative engagement with others still continued to think about teacher leadership as actions that primarily are led and directed by one person. They did not recognize the usefulness of the variables that contributed to their collaborative interactions with multiple learning tools. In this way, the activity system was missing important parts to allow for a more unexpected dynamic from within the system (internal contradictions) or from outside (external contradictions).

Teacher leaders need strong communication skills to collaborate within different contexts

Again, we use Figure 4 to explain the activity system of *subjects, tools, community, rules, objects and outcomes* for this finding.

In order to promote change in schools, the Fellows as teacher leaders acted as agents of the activity. In this capacity, they identified themselves as marketers who influenced other teachers. Working with their peers and encouraging change were activities mediated by *tools* such as the communication and marketing skills the Fellows needed in order to reach varied audiences and promote innovative science education. The Fellows discussed the importance of involving other members of their communities who they recruited and with whom they collaborated to work toward determined goals of change. As Jill explained, a teacher leader relies on communication with the right people: 'But you may need more [to work with parents, business leaders, and policymakers]. The communication is more important than the content' (Interview 2, January). Annie said, 'They are usually the one that is trying to reach out more to the community, or reach in' (Interview 3, August). The Fellows clearly recognized the *community*, which represented all of their potential collaborators, as an essential component within the activity system in order to achieve the desired object and outcome. A third fellow, Oscar, emphasized that teacher leadership cannot be done in isolation. He shared:

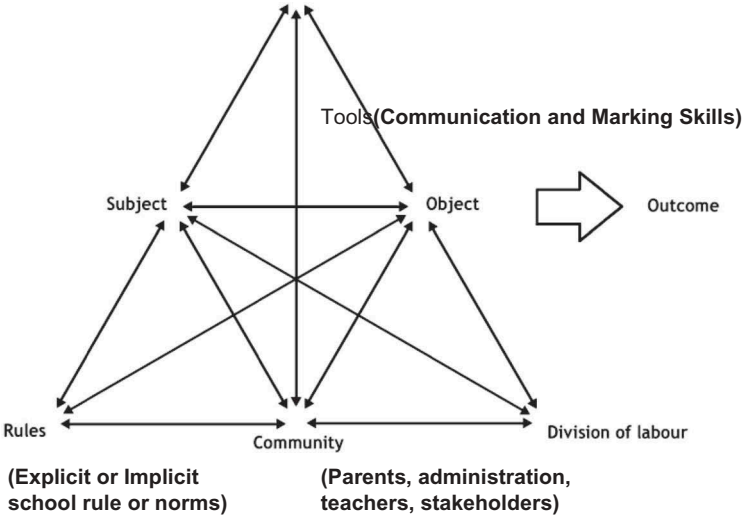

Figure 4. Activity System for STLs as change agents. Adapted from Daniels, H., Guiterrez, K. D., & Sannino, A. (2009). Learning and expanding with activity theory (p. 89), York, England: Cambridge University Press. Adapted with permission.

> You have to build those teams of people that will do it together or help each other out or work toward the common goal not … you know the leadership that is really one person just running the show. (Interview 3, August)

All three examples demonstrated an expanded activity system that included more components and interactions within the system. The Fellows or subjects described the necessary skills or what activity theory calls tools they needed in order to reach the stakeholders or community, which is essential to utilizing teacher leaders as change agents in schools, the ultimate object and outcome.

Sue felt that as a teacher leader you need to be very 'careful and diplomatic' in your conversations with others as you bridge the work to outsiders. This notion added another activity theory component, that of social rules and norms. Fellows noted that teacher leaders need to 'feel comfortable working with administration from the science supervisor all the way to superintendent' in addition to being able to work with fellow teachers in a 'very professional way' (Interview 2, January). They suggested that in collaborating with peers, they needed 'a mix of empathy and … I guess strength, to look for what they are having trouble with' (Interview 3, August). Oscar described how to talk to peers in the following way: 'My language is more casual … need the magic combination of strength and authority and mixed with humbleness and respect' (Interview 2, January).

Because most of them saw the nature of their work as relational (Donaldson, 2006), they reflected deeply about how they communicated with others and the kinds of relationships they developed through their work. The notion of relational teacher leadership is one that is less about formal roles and more about the 'spaces' between people, and how those spaces and relationships inspire others to engage in practice. This resonates with xxxx, xxxx, xxxx, xxxx, and xxxx who write, 'Thus, a key asset of teacher leadership is mobilization of naturally occurring and informal collaborations among teachers' (p. 921). This can involve

using a variety of different strategies including, as Fairman and Mackenzie (2015) describe: 'sharing, modelling, coaching, collaborating learning together, and advocating' (p. 70). Miranda highlighted that 'they need to talk to teacher[s] so they don't talk down, when giving professional development its more working together with them, not talking at them' (Interview 2, January). Essentially, Fellows need to have a working knowledge of the social rules as well as ways to navigate them to successfully reach the community.

Jill shared that her role was as a point person who engaged her peers in learning:

> I guess it would be to get our district ready for Next Generation Science Standards … my focus with the Growth Plan System. Just getting people comfy and rewriting curriculum. Also being positive about sharing what I learned over the past year'. (Interview 3, August)

In this particular activity system, the Fellows understood their colleagues' frustrations, but saw their roles as helping to support this particular change. Reaching out to their administrators and fellow teachers, they were advocating for innovative science curricula in their schools.

From the above discussion, we see that the Fellows' identities as teacher leaders had to be fluid in order to access different communities. Multiple Fellows shared about the need to 'adjust to who your target stakeholder audience is' when communicating. This demonstrates some progress in beginning to understand that teacher leadership involves more than just individual acts. It involves mobilizing others to work with them toward change. But interestingly, by using activity theory, we were able to observe the static and one-directional nature of this mobilization and how limiting this individually driven agenda was, and what aspects of the context were not taken up to create a shared vision.

Teacher leaders benefit from work on vertical articulation

This finding is represented by Figure 5 that highlights the tools, rules and community of the activity system and how all three of these directly impact the subject's progression through the activity system.

Our data indicated the Fellows developed professionally as a direct result of interacting across districts in vertical groupings made up of elementary, middle and high school science teachers. Because the vertical groupings were structures of the program, the activity development invited the Fellows to grow professionally as teacher leaders and deepen and apply their tools or pedagogical content knowledge (Shulman, 1986) related to curriculum, student understanding and teaching practices. This was done through attention to the *rules*, the *implicit and explicit norms of the vertical groups*, and participation in the *community*, made up of *the vertical groups, other fellows* and *district coordinators*.

Fellows gained a deeper understanding of the K-12 curricula, became better equipped to work with teachers at various levels and were involved in deeper discussion that required them to investigate student conceptions and misconceptions. For example, several teachers discussed the heightened awareness of students' prior educational experiences which, as Oscar put it, 'enlightened me as to what to expect when students arrived' (Interview 2, January) to consider revising their instructional approach.

Through their focused interactions and reflections, which are represented by the rules of the vertical groups, Fellows became aware of their own transitions toward

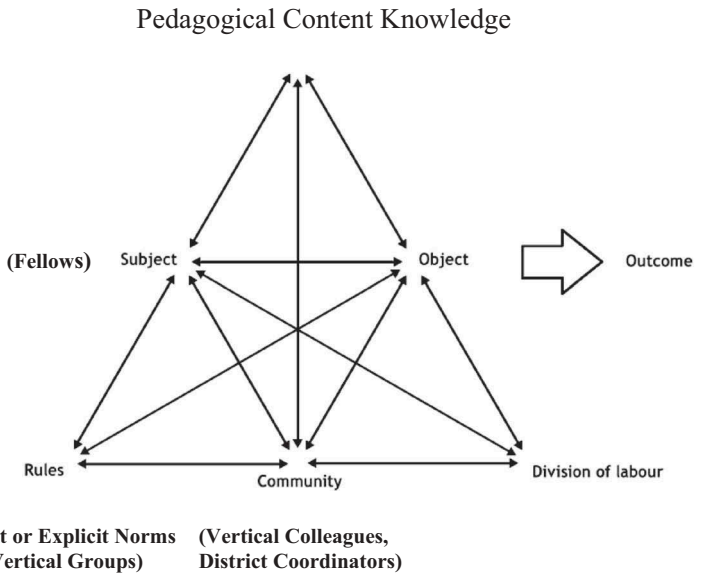

Figure 5. Activity System for STLs as change agents. Adapted from Daniels, H., Guiterrez, K. D., & Sannino, A. (2009). Learning and expanding with activity theory (p. 89), York, England: Cambridge University Press. Adapted with permission.

inquiry-based teaching and the requisite need to increase pedagogical content knowledge. Fellows relied upon this knowledge to support students to 'think like scientists', stray from the textbooks and encourage student-driven dialogue with the overarching goal of increasing student learning in the sciences. Sue commented: 'We need to let go and give more control to kids. It's challenging, but I see the light at the end of the tunnel' (Debrief Transcript, Vertical Group). The collaborative environment, fostered by the rules and community, pushed them to question their long-held practices: 'I want to teach in the old style … but kids don't do that (n)or do they like it. They may learn it for an exam … but they don't keep it' (Interview 2, January). Through their collaboration, they recognized each other as 'experts' and appreciated the opportunity to watch the 'best' teachers implement similar lessons using different instructional methods. This type of exchange broadened their teaching repertoire and also helped them to collectively identify ways to revise and innovate science teaching and learning.

Through the use of activity theory as an analytical lens, we noted the imbalances that emerged between the subjects' interactions with rules and tools from several vertical groups between structures. Imbalances are developmentally significant and exist in the form of resistance to achieving the goals of the intended objective (Engeström, 1999). For example, the high school teachers were surprised by the capabilities of elementary and middle students leading them to realize the need to raise their expectations of students. This highlights the impact between interacting components of an activity system, and specifically how infrequent the conversations are typically between teachers from different grade levels. By having Fellows work through these tensions given the rules and norms of the vertical grouping, they noted a newfound appreciation for teachers of lower grades. The elementary teachers impressed their colleagues with their pedagogical content knowledge

related to science at their grade level. As Jill remarked, 'the elementary teachers were really doing science … because, sometimes, you know, you don't know because it's not their major' (Debrief Transcript, Vertical Group). This comment indicated the rarity of communication between science teachers of different grade levels without the inherent structure of vertical articulation. Fellows recognized the value of crossing community boundaries, an area that was once risky, now had become possible because of the tools, rules and community.

Activity theory helped us to realize that to some extent the success of the vertical team collaboration was in part because of the ways in which these teams were created through the fellowship program. Both the Fellows as well as the district coordinators noted that vertical teaming was not a common collaborative leadership process within their districts. So by creating this 'artificial' type of leading with others, we drew attention to the kinds of rules, community culture and structure of the program necessary for Fellows to work toward achieving their goal. It served as an entry into thinking about the interplay between Fellows as agents of change and the professional and contexts within which they work. Endeavors like vertical collaboration, however, also revealed to Fellows aspects of their leadership interactions that were missing within their own district contexts.

School culture and administrative support influences teacher leadership

In order to articulate this final theme, we developed Figure 6 that focuses on the division of labor and the rules of the activity system.

The school and district culture and administrative support were important structures which influenced the Fellows' ability to take up teacher leadership actions. The division of labor within the different districts affected our Fellows' teacher leadership role. Fellows were directly connected to others (district coordinators, department supervisors and principals), and these complex links represented the organization of individuals or division of labor within the activity system of each fellow. Since all Fellows had the same goal within their activity pathway, to become teacher leaders and promote change, the level of engagement by the district coordinators, department supervisors and/or principals affected the outcome of improved teaching and learning. This was surprising to us as all of the

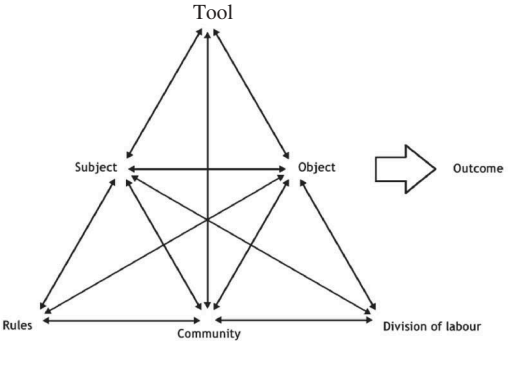

Figure 6. Activity System for STLs as change agents. Adapted from Daniels, H., Guiterrez, K. D., & Sannino, A. (2009). Learning and expanding with activity theory (p. 89), York, England: Cambridge University Press. Adapted with permission.

participating districts were selected based on enthusiasm and interest in nurturing science teacher leaders.

System imbalances can arise when there is a conflict between different processes in the activity system. Though Fellows acknowledged that their administrators supported them with resources, they felt that they were often neglected and lacked administrative support for their work. This showed us how the division of labor component caused tension with the subject's pathway toward her outcome. In particular, Annie shared that too often their administrators lacked specific expertise in science instruction: 'Neither one of my administrators are science oriented. So, I think they probably don't know if I am teaching correctly or not' (Interview 3, August). If administrators were more knowledgeable about science pedagogical content knowledge, they could focus on what a Fellow called 'the power of teaching science' (Interview 3, August). This awareness encouraged them to promote science learning, the direct outcome wanted by the Fellows. Problematizing this frequent dilemma in schools, Miranda suggested that her role could become that of a liaison to explain science standards and instruction to administrators and 'bridge the gap' (Interview 3, August). Ultimately, Fellows articulated their hope that administrative support would move beyond material resources to deeper pedagogical commitments around innovative science instruction.

Different stakeholders within an activity system often have different rules to guide them within their activity. As Fellows reflected on their emergence as science teacher leaders in their schools and districts, they repeatedly pointed out the time demands necessary for these new and often informal and unofficial roles. They willingly took on these added responsibilities as teacher leaders because of their professional commitment to their students and schools, but continually were surprised at the infrequent recognition by their administrators. As Beth stated, 'I think a lot of teachers do think they don't get appreciated much . . . If you do something wrong, there's a big meeting about it, but if you do something that's right, it's like, 'well, that's nice' (Interview 3, August). Miranda remarked:

> We haven't been acknowledged at all. The person in charge has yet to call us out or even acknowledge us at a meeting. We have been left to our own devices. This really disappoints me because the district acted as if they supported this'. (Interview 3, August)

Jill shared her frustration:

> I've been doing this 12 years and no one has told me if I am a teacher leader. Now to sit and work with other teachers I never met and realize I am doing it right and my vision is positive really helps me and motivates'. (Interview 2, January)

Needing external recognition to increase motivation, we realized that teacher leadership could not flourish in isolation. With little-to-no support from building administrators, the tensions of the activity were underscored causing challenges for Fellows to enact their teacher leadership.

Without placing blame on the administration, Fellows observed that bureaucratic pressure from increased correlation of teacher evaluations to students' standardized test scores (an initiative which begun during our first year of the fellowship program) has impacted the culture of their schools and has shifted the focus from instruction to excessive paperwork. So much time is spent 'documenting and data logging and thinking of ways to make more data . . . so then the part that is important, spending time doing lessons and collaboration with other teachers' is neglected (Interview 2, January). Such rules created

school cultures that made it difficult for Fellows to become change agents. These types of environments either blocked change or did not have mechanisms to recognize weak areas that needed improvement. Fellows acknowledged that their charge involves significantly changing science curriculum, teaching and fundamental beliefs about teaching science, which at times felt daunting and counter to the norms of the school. Jill described her attempts with new curriculum as a 'double edged sword' because of the angry responses of some of her colleagues. She pointed out 'sometimes you have to step in and put your say in there… If they adjust it or knock you down so be it' (Interview 2, January). Ultimately, being a teacher leader and making change was challenging and required a certain willingness to take risks.

Activity theory helped to reveal the importance of the foundational components that formed the base of the activity: namely the rules, community and division of labor. To be an effective teacher leader necessitated having local administrators like department chairs and/or principals involved in the activities necessary to make change. In our case, although we had science district coordinators participating in the program, these may not have been the building administrators of our Fellows. Without direct support and more importantly active engagement from local administrators, some of our Fellows struggled to make impact, encourage their colleagues to get involved or even feel confident to take risks.

This study used activity theory as an analytical framework to examine the role of Fellows in teacher leader positions toward sustainable change. Using an activity system that situated the Fellow in various contexts revealed the consequences and tensions that emerged for Fellows in our program. Our research has confirmed that activity theory, as a framework for analyzing data, provided a means for observing the emergence of patterns in human activity in terms of achieving goals and purposes, through the use of mediating tools and artifacts. In other words, activity theory illuminated the multiple contextual factors that contributed to a Fellow achieving their ultimate outcome of sustainable school change.

Conclusion

Through the use of activity theory as an analytical lens, we realized that effective teacher leadership requires a shift from focusing on nurturing the individual fellow and her development as a leader to an emphasis on interaction and activity. To examine leadership and its impact, it is more useful to borrow from distributed leadership where the focus is on the activity and its particular contextual factors such as the leaders, followers and situations. As Spillane et al. (2004) write, 'Depending on the particular leadership task, school leaders' knowledge and expertise may be best explored at the group or collective level rather than at the individual leader's level' (p. 25). This shift reveals the ways in which leadership practice is situated in cultural, historical and institutional settings and reminds us to consider how the practice of leadership is stretched over leaders, followers and the material and symbolic artifacts of the situation. We have begun to think about how promoting sustainable change through teacher leadership requires a multi-pronged approach where work is conducted with not only teachers, but also building administrators and district coordinators. We are also developing a notion of change that is collective as opposed to individual, recognizing that teacher leaders cannot work alone to make change, but must work alongside each other

for it to take hold. Moving away from thinking of the Fellows in terms of their individual personalities, dispositions and strategies has the potential to help us consider more integrative understandings of leadership at the level of the school and the various actors, tools and structures that are required for sustainable change. This echoes the work of Fairman and Mackenzie (2015) who advise moving away from 'notions of leadership in the narrow sense of the qualities a person has or what role he or she plays' (p. 81). We agree that teacher leadership is instead collaborative, interactive and always evolving.

These findings have important implications for our program and as well as the ways in which we study its impact. So far, we have mostly investigated our program's influence on developing teacher leaders and working with district coordinators. We realize now that we cannot really study the impact of our Fellows as teacher leaders if we do not do so within the context of their schools and alongside their district as well as building administrators. In our program, we worked collaboratively with the district coordinators but we have not explicitly focused on strategies to elevate the status of teacher leaders in the districts. In other words, to make significant impact we have realized that we need to work with building administrators to explicitly strategize how to best use and rely on the Fellows as teacher leaders to support sustainable change. Drawing from the work of Klar, Huggins, Hammonds, and Buskey (2016), we recognize the potential ability of principals to create leadership opportunities for teacher leaders, support them through their role transition and acknowledge the cyclical process of enacting teacher leadership. Additionally, we realize that how we do this needs to be context specific because what works for a particular endeavor in one district may not actually work in another district.

We are reminded of the importance of fostering school contexts that embrace and recognize the leadership capability of all members and support leadership as a form of agency that can be taken up around particular activities or endeavors by a variety of stakeholders (Harris, 2003). Extending leadership opportunities to teacher leaders is powerful in that it acknowledges the diverse and important roles that teachers undertake daily and how these tasks positively enhance the ultimate goal of teaching and learning (Harris & Lambert, 2003). It is clear that teacher leadership must be viewed with an emphasis upon collective action, empowerment and shared agency as reflected in a distributed leadership framework. Since leadership roles are played by multiple individuals, whether in formal or informal positions, the distributed leadership notion emphasizes the act of leadership is neither a top-down nor a bottom-up approach but recognizes that leadership roles are played by different people at different time, including teachers and school administrators (Harris, 2010; Spillane, 2006; Spillane et al., 2001). We believe our fellowship program has the potential to address this through co-constructing the organizational tools and structures necessary to support collaborative interactions and activities among teacher leaders and their school leaders.

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