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Supporting the Development of Science Teacher Leaders – Where Do We Begin?

Abstract

Teacher leadership has been recognized as a necessary ingredient to support educational reform efforts. Leaders provide the needed expertise to ensure reforms are successful in promoting student learning. The overarching goal of the *Leadership in Freshman Physics* program is to support a cadre of teachers-leaders who will become advocates for "Physics First" by developing their knowledge of physics content and research-based pedagogy. In order to support teachers in developing the knowledge, skills, and dispositions for effective leadership, it is important to first understand their initial views of teacher leadership and their prior leadership experiences. In this paper we present results from the initial phase of our multi-year research study in which we examine definitions of teacher leadership, teachers' past leadership experiences, and teachers' views of themselves as leaders. Participants include a cohort of 36 teachers participating in the program, each of whom has committed to teaching a year-long freshman physics course at his/her school. Our findings indicate teachers' definitions of leadership are relatively narrow, and often confined to formal leadership roles. Though teachers participate in numerous leadership activities, they don't explicitly consider these to be leadership. Implications for addressing teachers' conceptions through professional development are shared.

Physics First

Mr. Anderson recently attended a workshop where he learned new teaching strategies and curricula to implement in a freshman physics course. He was excited about the possibilities for getting such young students to learn physics early in their high school career. After the workshop, however, he realized that implementing freshman physics may be an uphill battle at his school and therefore he would need to take responsibility as a leader to ensure his efforts would be successful.

For generations, high school science has been taught through the typical sequence of 9th-grade biology, 10th-grade chemistry, and finally 11th-grade physics. However, as highlighted in the story above, there are initiatives, collectively known as "Physics First," to invert the traditional course sequence to teach physics at the 9th-grade level. Yet transitioning to Physics First is no simple task. Such a reform effort impacts students, parents, teachers, and school administrators. Therefore it is necessary that implementation of Physics First be well-designed from the start (Korsunsky & Agar, 2008).

Several studies have focused on describing the implementation of Physics First, such as the study by Dreon (2006) on the implementation in 12 public and private schools in Pennsylvania. Other studies have focused on the effects of Physics First curriculum on students' learning gains (O'Brien & Thompson, 2009) and attitudes (Korsunsky & Agar, 2008). Although these studies highlight important aspects for the success of the program, little is known about the role teacher leadership plays in reforms for Physics First. The literature contains few examples of schools that have prepared teachers through professional development workshops and made the difficult transition to freshman physics. Taylor et al. (2005) described a Physics First PD program that was designed to address curriculum implementation, instructional practices, and content knowledge for high school physics teachers. To aid in promoting the program within the school, exemplary teachers were hired as teacher-leaders to help fellow teachers develop consistent pedagogical practices. Yet, little is discussed about how freshman physics teachers themselves develop the necessary leadership skills to help enact science education reform efforts within their own community. To encourage and sustain successful implementation of Physics First, teacher-leaders must act as resources and catalysts for science education reform at the secondary level (Larkin, Seyforth, & Lasky, 2009).

Problem

Teacher leadership is "the process by which teachers, individually or collectively, influence their colleagues, principals, and other members of school communities to improve teaching and learning practices with the aim of increased student learning and achievement" (York-Barr & Duke, 2004, p. 288). As such, teacher leadership is a necessary ingredient for educational reform. Effective leadership provides a catalyst for change, and is essential to implementing and sustaining curriculum reform efforts (Larkin et al., 2009). Leaders provide the needed expertise to ensure reforms are successful in achieving their intended effect—promoting student learning. National

Science Foundation's Math and Science Partnerships (MSP) program recognizes the importance of teacher leadership to the success of reform efforts. The MSP *Teacher Institutes for the 21st Century* specifically focus on "meeting national needs for teacher leaders/master teachers who have deep knowledge of disciplinary content for teaching and are fully prepared to be school- or district-based intellectual leaders in mathematics or the sciences" (NSF, 2010).

Supporting the development of teacher leaders is a critical issue for professional developers in MSP programs. Despite the recognized importance of teacher leadership, little is known about how teachers learn in practice to become teacher leaders (Liebermann & Miller, 2005). Indeed, the culture of schools and norms of the teaching profession may actually be counterproductive to supporting the development of teacher leaders. For example, norms of equity, privacy, and autonomy serve as barriers to leadership that involves exchanging advice and interacting with colleagues (Smylie, 1992). Thus, in undertaking efforts to support teacher leaders, understanding teachers' own perceptions of leadership and professional norms is an essential first step. *Leadership in Freshman Physics* is an NSF funded MSP that is designed to support 9th grade physics teachers in leading curricular reform efforts in their districts. The purpose of this study is to explore participating teachers' ideas about leadership, activities they consider to fall in the realm of leadership, and how they perceive themselves as leaders within their classrooms and schools. Through examination of teachers' initial conceptions of leadership and prior leadership experiences, we will provide insights into challenges professional developers may face in designing effective programs to support teacher leadership. We will also discuss practical implications of our work for teachers and those who work with teachers to support science education reform efforts.

Theoretical Framework

Individual leadership capacity is the knowledge, skills, and dispositions that enable teachers to enact change within the affordances and constraints of the organizational context, with the specific purpose of improving teaching and learning. Leadership serves a variety of functions that support change (e.g., collaboration, building and communicating an instructional vision, life long learning, etc.), and is conducted within various dimensions of practice (York-Barr & Duke, 2004). Leadership functions are achieved through a host of interconnected tasks that are carried out by actors through both formal and informal means as schools undertake reform. As Darling-Hammond and colleagues explain,

> …in the course of restructuring, opportunities to collaborate and take initiative are available at every turn. The specific teacher leadership responsibilities that evolve are not prescribed a priori but are varied, flexible, and idiosyncratic to individual school teams and their distinctive situations. (Darling-Hammond, Bullmaster, & Cobb, 1995, p. 103)

The above supports the notion that not all teachers will demonstrate leadership in the same way or work within the same domains. In a review of findings from over two decades of scholarship on teacher leadership, York-Barr and Duke (2004) identified seven different dimensions of practice in which teachers carry out leadership activities. Table 1 provides a list of teacher leadership activities within each of these dimensions.

In the present study, we use the dimensions of practice of teacher leaders as a framework to examine the ways in which teachers define leadership, the activities they consider to be leadership, and their prior experiences as leaders. Specifically, we focus on the following questions:

- How do teachers define leadership within their own professional contexts?
- What kinds of activities do teachers consider to be leadership?
- In what ways do teachers perceive themselves as leaders?

Context of the Study

The context of this study is an NSF-funded Math and Science Partnership (MSP) designed to support a cadre of teacher leaders to become advocates for excellence in physics content and research-based pedagogy. The program aligns with reform efforts to place "Physics First," or shift the traditional sequence in which coursework is offered in the high school, by preparing teachers to offer a freshman physics course. Seven core districts throughout the state are included in the partnership.

Teachers in core districts participate for three years by attending a summer academy, where they develop their understanding of physics and modeling pedagogy, and participate in both face-to-face and online interactions with other teachers and project staff throughout the academic year. As part of their professional development and involvement in the program, they are guided in developing, implementing, and evaluating an individualized leadership action

Table 1. Dimensions of Practice of Teacher Leaders (York-Barr & Duke, 2004)

Dimension of Practice	Example Teacher Leadership Activities
Coordination and management	Participating in administrative meetings and tasks.
School or district curriculum work	Selecting and developing curriculum.
Professional development of colleagues	Engaging in peer coaching.
Participation in school change & improvement	Working to implement new programs school-wide.
Parent and community involvement	Becoming involved with parents; encouraging parent participation.
Contributions to the profession	Participating in professional organizations.
Preservice teacher education	Building partnership with colleges and universities to prepare future teachers

plan. The leadership component of the program is guided by the assumption that teacher leadership should be embedded in teachers' practice. As such, the leadership action plan both supports and complements teachers' day-to-day efforts toward successful implementation of a freshman physics course and improvement of student learning.

Participants. All 36 teachers in the first cohort of the program consented to participate in the research. Of these, 18 (50%) were female. Years of teaching experience ranged from 1 to 18, with a mean of 4.3 years in the classroom (median of 3.5). The teachers hailed from 20 different school districts throughout the state, including both rural and urban areas. Thirteen had an undergraduate degree in education, while the remaining had undergraduate degrees in a variety of other areas (e.g., chemistry, industrial engineering, biology, agriculture, animal science). Only 2 participants had an undergraduate degree in physics, specifically. All participants were certified to teach (with two holding temporary or provisional certificates) and 5 of the participants had achieved certification to teach physics prior to joining the program. Twenty (55%) of the participants held master's degrees, which were all in areas other than physics (e.g., science education, administration, counseling).

Methods

Our methods of data collection and analysis included both quantitative and qualitative approaches, as described below.

Data sources. To address our research questions, we collected and analyzed multiple data sources. Our first data source consisted of teachers' self-reported prior leadership experiences, included in their applications to participate in the program. These responses were limited by how teachers defined leadership (which differed from teacher to teacher), and so additional means of data collection were sought to provide a more complete picture of the kinds of activities in which teachers participate that might be considered to be leadership according to the recent literature

(e.g., York-Barr & Duke, 2004). At the start of the program, we asked teachers to respond to the Teacher Leadership Inventory (TLI). This program-specific instrument was designed to elicit teachers' ideas about varying aspects of teacher leadership. The inventory, which was examined for face and content validity by researchers external to our project, consists of 30 items that included both formal and informal leadership activities, each of which falls within one of the seven dimensions of practice of teacher leaders (coordination and management, school or district curriculum work, professional development of colleagues, participation in school change and improvement initiatives, parent and community involvement, contributions to the profession of teachers, and preservice teacher education) summarized by York-Barr and Duke (2004). Teachers selected 'yes' or 'no' to the following questions about each item (a) Have you participated in this activity? and (b) Is this leadership? After completing of the inventory, we asked teachers to articulate their definition of teacher leadership. This served as the third primary source of qualitative data, and provided a lens through which we could interpret teachers' responses to the first two data sources.

Data analysis.

Quantitative Analyses. Deductive means were used to categorize teachers' self-reported leadership experiences and responses to the Teacher Leadership Inventory according to the seven dimensions of practice of teacher-leaders (York-Barr & Duke, 2004). We developed frequency tables and used these to generate profiles of teachers' leadership activities. Additionally, teachers' participation in and perspectives on leadership activities from the inventory were compiled into frequency tables to examine patterns and their relevance to teachers' views of leadership. For each of the seven dimensions of practice of teacher leaders, we calculated the percentage of teachers who (a) participated in the activity and viewed it as teacher leadership, (b) participated in the activity but did not

view it as teacher leadership, (c) did not participate in the activity but viewed it as teacher leadership, and (d) did not participate in the activity and did not view it as teacher leadership. We then compared the seven dimensions in terms of the relative percentages of respondents in each category (a) through (d).

Qualitative analysis. We selected grounded theory as our analytic framework (Glaser & Strauss, 1967). In grounded theory, researchers are to develop sensitivity to existing theories, but then set aside these existing theories in order to collect and analyze data with a fresh perspective (Strauss & Corbin, 1998). Initially, we analyzed teachers' definitions of leadership through open coding, or generation of low-inference codes that required little abstraction from the data. After initial coding, we developed categories through identification of redundancies, intersections, and hierarchal relationships between the initial codes. A careful review of the data enabled the identification of emergent themes, patterns, and structures. Typologies and classification schemes were constructed to organize themes and patterns, and to develop generalizations and propositions from the empirical data (Taylor & Bogdan, 1984). Data were connected within categories by constructing taxonomies. Spradley's (1979, in LeCompte, 2000) semantic relationships were used to organize items into meaningful structures.

Results

Quantitative findings. As part of the application process for the MSP program, teachers were asked to indicate their leadership experiences over the past 5 years. All but one of the 36 teachers reported having prior leadership experience. We categorized teachers' responses in relation to the seven dimensions of practice of teacher leaders (York-Barr & Duke, 2004) as shown in Figure 1. Of the 84 leadership experiences reported by teachers, the largest percentage (over 50%) was related to participation in school or district curriculum work, school improvement and professional development of colleagues.

Figure 1. Teachers' Prior Leadership Experience in Various Domains
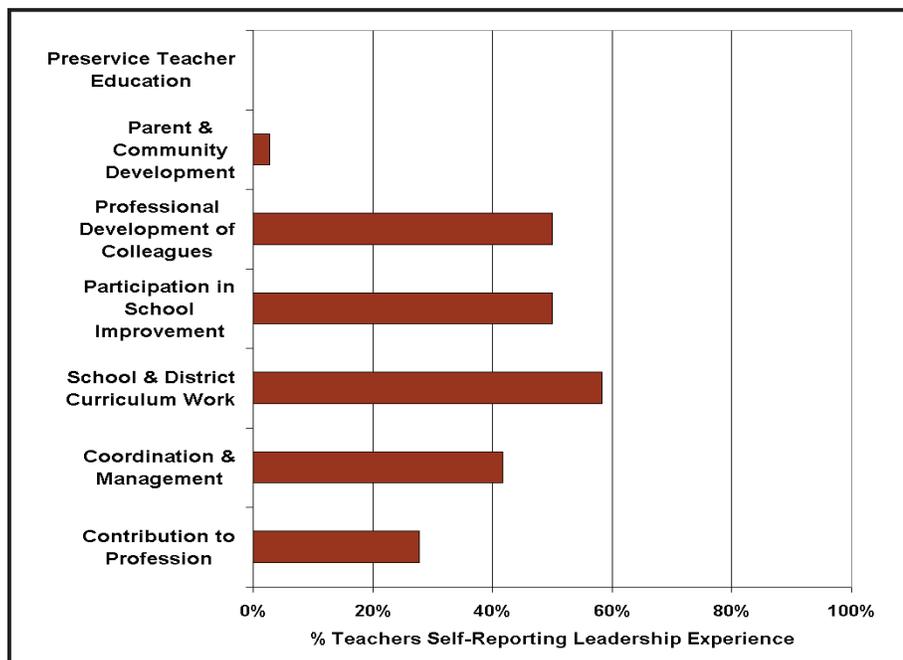
To a lesser extent (below 10%), their activities related to parent and community involvement. No teachers reported leadership activities related to preservice teacher education.

Results of the Teacher Leadership Inventory reveal differences between the types of activities in which teachers participate and the types of activities they view as leadership. While teachers report participating in many different kinds of activities within the dimensions of leadership identified by York-Barr and Duke (2004), they do not necessarily recognize these activities as being "leadership." At the opposite ends of the spectrum are the categories of "preservice teacher education" on one hand and "school improvement" or "school and district curriculum work" on the other hand. Over 95% of the respondents view preservice teacher education to be leadership, but only about 50% participate in it. Conversely, over 95% of the respondents participate in school improvement or school and district curriculum work (e.g., participating in textbook adoptions and developing common classroom assessments) but only about 60% view it as leadership. Other categories show a similar, though not quite as extreme a dichotomy. For instance, about 90% participate in "parent and community development" (e.g., participating in Open House or Curriculum Showcase events for parents) or "coordination and management" (e.g., helping plan schedules and programs), however only 60% and 70% respectively perceive these activities to be leadership. Similarly, about 80% of the teachers participate in "professional development of colleagues" although only 60% of them view this activity as constituting "leadership." The only category that is an exception to this dichotomous trend is "contributions to profession." Teachers approximately equally viewed/did not view making contributions to profession (e.g., presenting at conferences) as leadership and have/have not participated in this activity.

Qualitative findings. Teachers' definitions of leadership fell into two major categories; leadership definitions that highlighted *personal qualities* of a leader (e.g., positive attitude, trustworthiness, selflessness, sensitivity, etc.) and those that focused on *knowledge and skills of leadership* (e.g., expertise, competence, decision-making skills, organizational and facilitation skills). Twenty-five percent of teachers provided definitions that focused exclusively on one or the other category. Four teachers defined leadership as personal qualities of an individual. For example:

Figure 2. Teachers' Views of Leadership and Participation in Activities
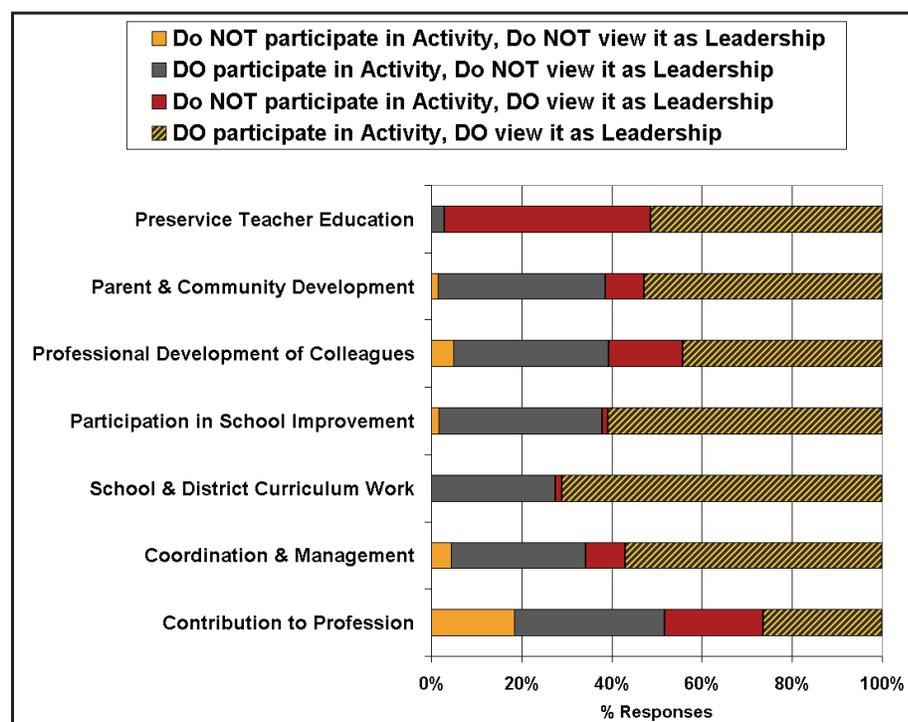
I have heard from some persons that self motivation is leadership. In my opinion, leadership stems from within each person.

A leader is an individual who takes the initiative. He/she is responsible, respectable, and respected.

In contrast, six teachers emphasized leadership exclusively as the knowledge and skills of an individual who leads. For example:

The ability to analyze/ decipher what improvements are needed and then use the available resource to work towards achievement of these improvements.

Nonetheless, the majority (approximately 75%) of teachers provided definitions of teacher leadership that encompassed both of these elements, suggesting they view leadership as consisting of both knowledge/skills and dispositions/personal qualities. For example:

When I think of a good leader I envision a person who is positive, believes in what they are doing, and knows how to motivate others. A leadership role is for someone who can take charge and use their knowledge and use it to help others learn or move a group from one place in their organization to a better place.

Individual codes comprising each of the two major categories are provided in Table 2 below.

Discussion

Teacher leaders can provide the necessary scaffolds to achieve educational reform efforts such as Physics First. Yet, to promote effective leadership skills and dispositions, it is crucial to first understand teachers' ideas and perceptions about teacher leadership. The purpose of this study was to gain insight into teachers' views and their self image with regard to leadership. York-Barr and Duke (2004) identified seven different dimensions of practice in which teachers carry out leadership activities. Based on this framework, we created an inventory (TLI) to examine teachers' self-reported experience in each of these dimensions of leadership as well as their views and participation in these activities. We also asked teachers to describe their definitions of teacher leadership. Overall, we found that although the participating teachers had prior leadership experiences in almost all the dimensions identified by York-Barr and Duke (2004), they nonetheless were skeptical about their roles as leaders. A contributing factor was how teachers defined leadership; because they did not view particular activities as being related to leadership, they did not view themselves as leaders. Our results point to a mismatch between how leadership is defined in the literature and how leadership is defined by teachers themselves. We highlight this incongruence as we answer each of the research questions below.

How do teachers define leadership within their own professional contexts? We found that teachers' definitions of leadership contained elements that fell into two major categories: *personal qualities* and the *knowledge and skills of leadership* (e.g., expertise, competence, decision-making skills, organizational and facilitation skills). The qualitative results of the study indicated that when defining leadership, most of the participating teachers give equal importance to inherent qualities of leaders and the knowledge and skills of leadership. One of these aspects has been supported by the literature as well; Pellicer and Anderson (2001) also emphasized the significance of shaping teachers in terms of leadership knowledge and skills so that they can become "Instructional leaders" (p. 14). While the vast majority included both elements in their definitions, a minority (25%) focused on either personal qualities of a leader OR knowledge and skills of a leader. The exclusive emphasis on personal qualities of a leader raises the question as to whether these teachers (either tacitly or explicitly) believe that leaders are "born" rather than viewing leadership as a skill that can be cultivated. In order to view themselves as leaders, these teachers would have to believe they possess personal qualities of a leader. Furthermore, it remains to be seen whether teachers who view leadership in terms of knowledge and skills or as a combination of personal qualities and knowledge and skills one possesses, may be more inclined to believe individuals can grow and develop as a leader than those who view leadership exclusively as personal qualities of an individual.

What kinds of activities do teachers consider to be leadership? Overall, we found that although the participating teachers had leadership experiences in almost all the dimensions identified by York-Barr and Duke (2004) most of them were skeptical about their roles as leaders. Results from the TLI indicate teachers are most likely to view themselves and their peers as leaders when they are engaged in activities pertaining to participation in two particular domains of practice: preservice teacher education activities and school or district

Table 2. Themes in Teachers' Definition of Leadership

Personal Qualities of Leaders	Knowledge and Skills for Leadership
Accountable	Has the ability to make a difference
Collaborative	Able to motivate others
Has good intentions	Organizational skills
Has vision	Can improve the school
Intrinsically motivated	Shares knowledge
Trustworthy	Has a formal role or position
Has a positive attitude	Has expertise & competence
Reflective	Decision making skills
Is a role model	Facilitation skills
Selfless	
Sensitive to others' needs	

curriculum work. Though teachers are engaged in a wide range of activities, they do not necessarily consider most of these activities to be leadership. For instance, teachers report participating in contributions to their profession and professional development of colleagues, but did not consider these activities to be leadership. The results of this study imply a contradictory nature to participating teachers' perception regarding leadership activities. For example, while describing their leadership experiences and defining leadership, teachers emphasized affecting their colleagues professionally, which was included as a component of teacher leadership practices by York-Barr and Duke (2004). However, teachers responded in the negative in terms of viewing professional development of colleagues as a leadership activity on the TLI. Similarly, teachers' responses to the TLI revealed that roughly half (45%) view preservice teacher education as a leadership activity, and also participated in it. On the other hand, in reporting their prior leadership experience, no single teacher mentioned any activities related to preservice teacher education.

There exists an interesting dichotomy between the activities that teachers engage in and those that they perceive as constituting leadership. In other words, most teachers do not view themselves as leaders, although they may in fact be engaging in activities that according to York-Barr and Duke's dimensions of practice <u>do</u> constitute important practices of teacher leaders. Our findings draw attention to teachers' lack of clarity in defining teacher leadership. Is it perhaps this unclear notion of leadership that makes them conclude that they are not leaders? Our findings underscore the importance of professional development programs such as *Leadership in Freshman Physics* in facilitating the formation of a common vision for teacher leadership, as well as the development of leadership skills among teachers to foster curricular reform efforts in schools and districts to better support student learning.

In what ways do teachers perceive themselves as leaders? Our findings reveal several myths about leadership that could potentially prevent teachers from viewing themselves as leaders. These include:

- Leadership requires a formal role or position
- Not everyone can be a leader
- Leadership takes place outside of the day-to-day activities of teaching

ALL teachers have the potential to be a teacher leader; by the virtue of their own efforts to bring about change in their own classrooms, teachers lead by example. Nonetheless, because teachers in our program often associated leadership with a formal role, they believed that not everyone is capable of serving as a leader—for example, teachers' definitions revealed they expected there to be one leader who "takes charge" and that all others follow. Teachers in our program also most often associated being a leader with holding a formal position or acting in an official capacity, for example, serving as a department chair, officer in a professional organization, etc. However, there are many informal ways in which teachers exert influence and make a positive difference in their schools. Lieberman and Miller (2005) stress that informally, teachers lead by serving as advocates, innovators, and stewards. As advocates, they speak up for what is best for student learning, framing and reframing issues so that student learning is the central focus. As innovators, they act as change agents, implementing new practices. As stewards, they positively shape the profession by contributing to their own professional growth and that of their colleagues. Finally, when asked to consider whether they viewed many of their routine activities to be forms of leadership, the majority of teachers responded 'no'—yet, these activities fell within the seven dimensions of leadership practices discussed above. In other words, teachers were already taking on leadership roles and functions in their schools, but didn't consider themselves to be leaders. They viewed leadership as being something above and beyond their day-to-day work as educators.

Implications

Teachers' perception of leadership may potentially affect their choice of pathways to accomplish their leadership goals (York-Barr & Duke, 2004). By understanding teachers' initial perceptions of leadership and the domains of practice that teachers consider to be leadership, professional developers can be better prepared, as we were in our project, to identify and address areas of growth for teacher leaders. Based on our awareness of these potential barriers, we have been able to design a professional development program for teacher leadership that provides opportunities for teachers to examine their conceptions of leadership and move beyond the "myths" about leadership they initially held. This assessment helped us identify fruitful starting points and to answer the question, "Where do we begin?" in supporting teachers to grow as leaders.

Programs and workshops that aim to develop teacher leadership should rely on such formative assessment to inform their ongoing efforts to help teachers develop a common vision for leadership, to tackle myths teachers hold about leadership that can inhibit their development as leaders, and to assist them in tailoring sessions to inform and cultivate teachers' leadership knowledge and skills. Teachers should begin with broadening their vision of various activities which fall within the scope of leadership. They should cultivate self-confidence in their leadership capacity and examine their perceptions of leadership as being detached from their daily teaching activities or being carried out only through formal roles. Administrators should begin with an effort to recognize the informal activities of teachers and leadership skills embodied in successful classroom teaching. They should identify opportunities for teachers to take on leadership roles within the different dimensions of practice of teacher leaders in such a way that it draws on the strengths and interests of their faculty. Professional developers can play a role in supporting the development of teacher leaders by helping the teachers develop a shared vision of leadership, explore the

leader within, and build their leadership knowledge and skills.

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