Exploring ninth-grade science teachers’ path of leadership for implementing educational reform efforts: A case study

Carina M. Rebello, Ya-Wen Cheng, Somnath Sinha, Deborah Hanuscin

MU Science Education Center
University of Missouri

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Author Note
Correspondence concerning this article should be addressed to Carina M. Rebello, MU Science Education Center, University of Missouri, 321-O Townsend Hall, Columbia, MO 65211, USA. Email: cp5xc@mail.mizzou.edu
Abstract

To enact new educational reform efforts, it is recognized that teacher leaders are essential to bring about the needed expertise to implement and sustain such efforts. Yet, little is known about how to support teacher leaders and why teachers implement certain leadership tasks. In order to support teacher leaders, it is essential to understand how teachers define teacher leadership within their professional context, what functions do teachers play as leaders, and what resources facilitate or inhibit their leadership functions. We report on a case study analysis of three 9th grade science teachers operating within a district implementing a new reform effort – Physics First. Data from multiple sources – demographics questionnaire, individual interviews, individualized leadership action plans, mid-year and year-end action plan progress reports, and teachers’ written definitions of teacher leadership – were used to inform this study. Results suggest that eight material/social/cultural resources facilitate teacher leaders implement leadership actions: colleague, administrative, parent and student support; time for professional development; technology; professional development support; collaborative/collegial environment; and confidence/introspective. Teachers’ self-image as a leader may influence the choice of leadership functions fulfilled and how they might utilize available resources.

Key words: teacher leadership, physics first, professional development
Introduction

The National Science Foundation’s (NSF) Math and Science Partnerships (MSP) program recognizes teacher leadership as a necessary feature for the successful implementation and sustainability of educational reform efforts. Teacher leaders provide the needed expertise to ensure reforms are successful in promoting their intended outcome—improved student learning (Dozier, 2007). Supporting the development and growth of teacher leaders is thus a critical issue for professional developers in MSP programs. Loucks-Horsley, Hewson, Love and Stiles (1998) propose principles of effective professional development. Developing teacher leadership is one of the essential components of effective PD.

Despite the recognized importance of teacher leadership, little is known about the pathways through which teachers may lead and how teachers can be supported in developing as leaders (York-Barr & Duke, 2004). Thus, in undertaking efforts to support teacher leaders, understanding teachers’ own perceptions of leadership and their present experiences of being a teacher leader are necessary. Spillane, Halverson, and Diamond (2001) describe that it is important not just to know what teachers do as leaders, but to generate in-depth descriptions and understandings of how and why they implement certain leadership tasks.

Research Questions

The overarching goal of this case study is to understand the factors that influence the success of three teachers in becoming teacher leaders within their school and district as they implement a new educational reform effort – Physics First (PF). More specifically, we are interested in identifying resources that may act as facilitators and/or barriers that influence
teachers’ leadership paths as they implement a personal leadership action plan. Our research questions include:

- How do teachers define leadership within their own professional contexts?
- What function(s) do teachers play as leaders within their school’s implementation of Physics First?
- What factors/resources influence their leadership pathways?

**Conceptual Framework**

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). Crowther, Kaagen, Ferguson, and Hann (2002) also suggest “teacher leadership as we intend it, is about action that transforms teaching and learning in a school, that ties school and community together on behalf of learning, and that advances social sustainability and quality of life for a community” (p. xvii). Moreover, the benefits of teacher leadership include: 1) enhanced employee participation, 2) development and sharing of expertise about teaching and learning, 3) acknowledgment, opportunities, and rewards for accomplished teachers, 4) improvements in student learning (York-Barr & Duke, 2004). Therefore, teacher leadership can have a great impact on teachers, schools, students and teachers themselves. There are a wide variety of activities in which teachers can engage in as leaders which include: developing and distributing curriculum and/or materials, mentoring new teachers, coordinating professional development, participating in decision making, etc. (Gigante & Firestone, 2008). Teachers can take on formal and/or informal roles as teacher leaders. Teacher leaders lead within and beyond the classroom, supporting other teachers as learners and leaders, and encouraging
others to improve their practice for the benefit of all students (Katzenmeyer & Moller, 2009). They can also work at the organizational level to align personal, fiscal, and material resources to improve student learning (York-Barr & Duke, 2004). For the reasons cited above, teachers leadership has been considered as key to teacher professional development. Locks-Horsley et al. (1998) proposed seven principles of effective teacher professional development, which explicitly address the importance of developing teacher leadership when designing a PD program.

To examine the impact of a professional development program that included a focus on developing teacher leadership, we relied on the theory of “distributed leadership” as our framework for this study. A teacher’s individual leadership capacity is the knowledge, skills, and dispositions that enables her/him 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) including coordination/management, professional development of colleagues, etc. Leadership functions are achieved through a host of interconnected tasks that are carried out by actors through both formal and informal means. Thus, leadership, as a phenomenon, is best understood as a distributed practice stretched over the school’s social and situational contexts (Spillane et al., 2001).

Distributed leadership theories consider a school as a unit of analysis as opposed to the individual leader, and provide a lens for understanding how leadership practice is distributed among both positional and informal leaders within a school and/or district and contexts (Spillane et al., 2001). Leadership in this context “involves the identification, acquisition, allocation, coordination, and use of the social, material, and cultural resources necessary to establish the
conditions for the possibility of teaching and learning” (Spillane et al., 2001, p. 24). Teacher leadership depends in part on environmental factors. Thus, one way to conceptualize the school environment is to conduct a resource analysis of material, social, and human resources (Gigante & Firestone, 2008).

All teachers have the capacity to be a leader; by virtue of their efforts to bring about change in classrooms and schools (Barth, 2006). “When given opportunities to lead, teachers can influence school reform efforts. Waking this sleeping giant of teacher leadership has unlimited potential in making a real difference in the pace and depth of school change.” (Katzenmeyer & Moller, 2001, p.105). However, the culture of schools, norms of the teaching profession, and available resources may actually be counterproductive in supporting teacher leadership. For example, norms of equity, privacy, and autonomy serve as barriers to leadership that involves exchanging advice and interacting with colleagues (Gigante & Firestone, 2007; Smylie, 1992). Thus understanding how teachers’ view leadership, what environmental resources influences their leadership, and their leadership functions as they collaborate with colleagues and other leaders are necessary for promoting teacher leadership at the school and district levels.

Methods

Context of the Study

The context of this study is an Leadership in Freshman Physics, an NSF-funded Math and Science Partnership (MSP) project providing professional development designed to support 9th grade physics teacher for successful implementation of the ‘Physics First’ (PF) curriculum or shifting the traditional science course sequence to place physics before biology and chemistry. The overarching goals of the project is to develop a cadre of teacher leaders to become advocates for excellence in physics content and research-based pedagogy, strengthen high school freshman
science teachers’ and students’ understanding of physics, enhance teachers’ pedagogy and confidence in teaching freshman physics, promote institutional change among core partners institutions, and improve students attitudes towards science. Furthermore, the project aims to investigate how professional development of 9th grade physics teachers in leadership, content and pedagogy contributes to their growth as teacher leaders. The program focuses on the contribution of these teacher leaders leading curricular reform efforts in their school districts i.e. successful implementation of Physics First (PF) curriculum. The structure of the project aims to support teachers’ continued learning and professional growth throughout the school year.

This leadership development program is based both on traditional face to face and online means. Each teacher attends a four-week summer academy in which they go through four whole-day workshops dedicated to honing of their leadership skills as advocates (speaking up for best interests regarding student learning), innovators (implementing new practices and acting as change agents) and stewards (contributing to the profession by helping their own growth and their colleagues) (Lieberman & Miller, 2004). During these sessions teachers go through various literature related to leadership, try to understand the vast scope and various possible avenues of teacher leadership – formal and informal, understand and identify their roles as teacher leaders, discuss and try to find potential solution of different barriers, etc. Finally, every teacher develops a customized action plan depending upon their interest, aspects and anticipated challenges to be faced regarding implementation of PF in context of their school, and any leadership skill of interest which they want to cultivate. They also create a time line for action and periodical communication and evaluation of their action plan. In order to support their growth of leadership skills throughout the academic year, these teachers enroll in a one credit graduate level course called Leadership in Science Education. They draw upon their learning from the summer
workshop by engaging themselves in various leadership activities during rest of the year. They are supported by their professional learning community groups, coaches, mentors, and university faculty through face to face and online means. Additionally, they blog monthly and participate in online discussion forums and chats during the year. These electronic communications help them to reflect on their growth as leaders, discuss failures and success related to their practice of leadership.

Participants

The cohort of participants comprised of 36 teachers, each of whom has committed to teaching a year-long freshman physics course at their school. Gender wise, this cohort had equal representation. Teachers came from different school districts (20) throughout the state representing rural and urban areas. The teaching experience of all the teachers varied from 1 to 18 years with an average of 4.3 years. Qualification wise, all the teachers had an undergraduate degree and 20 (55%) of them had masters degree. However, only 13 (36%) of them had an undergraduate degree in education. Specifically regarding physics, only 2 (5.5%) of them had an undergraduate degree in physics and none with a master’s degree.

Out of the 36 teachers, three secondary education teachers from a Midwestern 9th grade center were purposefully selected using criteria for intensive investigation (Hatch, 2002; Patton, 2002). These teachers (Jerry, Kramer, and Elaine) worked within the same science department at a participating school. The choice of participants was influenced by (a) completion of all data collection task requirements in the study; (b) location and availability for one-on-one interviews; and (c) that participants collaborate with each other in the same school and district that is newly implementing PF. While some teachers’ districts had begun their own initiatives to implement Physics First prior to this NSF-funded effort, this was the first year for the case study
participants’ district and school to be implementing PF. No other teachers within the district and school were familiar with nor have undergone any form of PD training for PF. This was also the first year for each of the participants to teach physics, which is reflective of the broader cohort in general. In this sense, we hoped the selected teachers would exemplify the impact of the program on their leadership in implementing PF.

Jerry, Kramer, and Elaine all taught at a Midwestern 9th grade center. This center has a total enrolment of 689 which includes 278 students with free/reduced lunch. In comparison to the state average of 47.2% of students with free/reduced lunch this center has a percentage of 40.3%. The student population mainly consists of white Americans (76.6%) with African Americans, Hispanic, Asian and Indian students encountering for 18.7%, 2.5%, 1.7% and 0.40% respectively. The diversity status of the student population is at par with the state average. The student teacher ratio is 16 which is higher than the state average of 13.4 however all the teachers here have regular certification. The status of 9-12 grade dropout rates is 1.3% which is lower than the state average of 4.3%.

Jerry had been teaching for 18 years, and currently served as science department head. His prior experiences include teaching in earth science and physical science. He is certified to teach science through grades 5-9 and physical education through grades K-12. His initial idea of leadership was primarily associated with formal roles or positions of authority – “my previous mindset was that leaders were the ones with the ‘big picture’ thinking and the goals and vision of the organization in mind. They, most usually, were the ones with the important titles and big offices.” He had some prior leadership experience gained through staff training on the use of smart boards in class and presented on that topic at a state teachers conference. His stated reasons for applying to the program included a concern about providing a challenging curriculum
compared to his students’ capability, as well as the personal challenge of learning new material and applying it in classroom. His action plan goal for implementing PF was to help improve pedagogical practices for himself and his colleagues – “building and forming a team that would observe and evaluate each other, presenting ideas that could help each of us improve our teaching.”

**Kramer** had been teaching for 8 years. He had taught basic science in 7th grade and earth science in 9th grade. He is certified to teach science through grades 5 to 9. His initial idea regarding leadership was of the process of influencing others – “I believe a leader is one who has the ability to influence others. Granted this definitely does not touch base on the qualities of a positive leader, but let's face it, leaders influence people in some way shape or form.” His prior leadership experience involved serving on a committee in the district related to the restructuring of the middle school and completing master’s coursework in educational administration. Unlike Jerry, Kramer did not have any formal leadership position in school. For his action plan, he wanted to convince his fellow science teachers of the importance of the PF curriculum with regard to student success and to promote the PF program to community, colleagues, and administrators.

**Elaine** had been teaching for 10 years. She has prior teaching experience in earth science, chemical biology, chemical biology II, biology and human biology. She has a unified science teaching certification for grades 9 through 12 with a major in biology and minor in chemistry. Her initial idea of a leader was being highly visible and outspoken – “I used to think...that all leaders were the ones out in front that did all the presenting and had the loudest voice.” She had prior leadership experience starting a medical academy at a high school, along with three other teachers, but did not hold any formal position of leadership. She had some reluctant colleagues
regarding teaching of PF in her department and so she designed her action plan to lead by example, promoting faculty buy-in of the curriculum and modeling pedagogy and encouraging participation in classroom observations and peer feedback.

**Data Sources**

To address our research questions, we collected and analyzed multiple data sources, which included a demographics questionnaire, individualized action plans, mid-year and end-year reports of action plans, individual semi-structured interviews, and teachers’ written definitions of what leadership is prior to and after the PD program. As part of the PD application, participants completed a demographics questionnaire. The demographics questionnaire was used to construct individual case profiles and included questions such as: number of years teaching/teaching physics, and prior experiences of leadership.

As part of the PD program, teachers develop a year-long individualized action plan to carry out during the academic year. The purpose of the action plan is for each teacher to identify a goal or pressing concern about implementing PF, challenges they may face while achieving their goal, roles and actions they will take as a leader to meet their goal. They also identify leadership skills they need to develop, what they must learn, and resources needed to carry out their actions. They also develop a timeline for action, a plan to evaluate their outcomes, and strategies for communicating or sharing their outcomes. Through developing and carrying out their personalized leadership action plans, teachers are guided using mid-year and year-end reflection reports and feedback from PD staff in evaluating their effectiveness as a leader and further developing their capacity for leadership within their school, district, state, and beyond.

Individual interviews lasting approximately an hour long and consisting of open-ended questions was conducted at the start of their second year in the program. The purpose was to
understand their view of what leadership is and how it may have changed for them over the course of the year, clarification of the path of leadership reported in their action plan and why they chose that path, what resources were needed, what facilitators or barriers did they experience as they implemented their action plan, and what success and challenges did they experiences while implementing their action plan.

**Data Analysis**

Data analysis was guided by a case study approach (Stake, 1995) – three teacher leaders within a school district implementing PF served as our case. Interviews were recorded and transcribed verbatim. Transcripts, action plans, and written artifacts were separately coded by two researchers to ensure that the themes emerging from the interviews are the same as the ones emerging from the action plans and written artifacts. All data was inductively, openly coded with descriptive and explanatory codes and using meaning of analysis for each participant. Codes were then collapsed to reduce redundancies and group similar codes together. Themes then were developed from a refined code list for each case. York-Barr and Duke’s (2004) dimensions of teacher leadership appeared to be to best suited for the themes that emerged from our data relating to teachers’ leadership functions. Several methodological strategies were employed to establish trustworthiness of the findings (Guba & Lincoln, 1989). Strategies to validate interpretations included: triangulation of data sources; rich, thick descriptions; peer review; and clarifying researcher bias.

**Findings and Analysis**

Findings are outlined below and organized into three major sections. The first section describes how the teachers define leadership followed by a description of leadership functions and finally a description of social/material/culture resources influencing leadership pathways.
Defining Leadership

There were three themes that emerged from the data regarding how leadership is defined among the teachers. Each theme – positions and activities of leadership, knowledge and actions of leadership, and intrinsic personal qualities of leadership – is described below.

**Positions and activities of leadership.** It is commonly recognized that a teacher leader can assume many different roles and undertake numerous tasks which are indicative of leadership in nature. As Kramer states, “I always felt like there are so many different roles teacher leader can play. Whether you are the person that leads by example, a person that is consistently involved, a person that is always bringing new ideas, I’ve always felt like there are multiple roles of leadership that teachers can play throughout the building and throughout the school district.” Although Jerry initially view leadership as fulfilling duties associated with titles and offices, he later states, “I believe that leadership takes on many different looks, it can be the teacher in the classroom…, or the board president leading policy change.” Jerry adds that leadership activities can occur both in school/classroom or outside the school within the community. Kramer extends this notion by suggesting that a teacher’s leadership role can change over time. Especially as they become more confident with their abilities to take on new tasks.

Participants also offer specific examples of leadership while defining teacher leadership such as: facilitating a peer learning community, writing articles, serving on a committee, lead by example, etc. Moreover, Elaine describes that a teacher is a leader, “I would say, a matter of fact you want to become a teacher, you are a leader to your students.” Hence teacher leadership can be embedded within their everyday tasks as being a teacher.

**Knowledge and actions of leadership.** Jerry, Kramer, and Elaine additionally express that a teacher leader demonstrates a level of knowledge and actions of leadership. Specifically,
sharing knowledge and ideas with colleagues and encourages others to do so as well, exhibits a level of expertise and competence, is a motivator and facilitator, and works toward school improvement. An example offered by Kramer is, “I’m a big advocate of what I call the shared leadership approach, because I think it is important to ultimately get everybody’s opinions and ideas before we carry through and follow through some of the actions that we planned.” A leader should be able to share ideas, motivate others to contribute, and work with others to achieve common goals as a team. Not only can a leader’s knowledge and leadership actions impact colleagues, but can impact students as well. As Elaine states: “as a teacher leader our responsibility is to provide direction to students.” Elaine continues to explain that is important to be a role model for students. Thus actions undertaken by teachers to impact students and learning can be considered as leadership.

Intrinsic personal qualities of leadership. Each of the participants indicates that a teacher leader should possess intrinsic personal qualities of being a leader. These qualities can include: motivation and commitment, being a lifelong learner, having a positive attitude, selflessness, accountability, having a vision or being goal oriented, involved or being a risk taker, and reflective. As previously describe by Kramer what teacher leadership means to him stating: “I’m a big advocate of what I call the shared leadership approach because I think it is important to ultimately get everybody’s opinions and ideas before we carry thought and follow through some of the actions we had planned.” Here, Kramer describes a leadership role, shared leadership, as requiring such personal qualities as selflessness and valuing peoples’ opinions and ideas. While defining what leadership is, Jerry listed several intrinsic characteristics that a leader should posses. These include: having a vision, plan, or goal; selfless and compassionate; inspire and motivate; support others; results orientated; accountable and responsible; and takes risks.
Across interviews and definitions, each of the participants describe similar qualities that a good leader should possess.

**Leadership Functions**

Four areas emerged as functions the participants serve as leaders within their school to help implement Physics First. Each of the participants described their leadership contributions or functions in ways that align with four of York-Barr and Duke’s (2004) seven dimensions of teacher leadership. Each of these areas – professional development of colleagues, parent and community involvement, participation in school change and improvement, and coordination, management – is discussed below.

**Professional development of colleagues.** Facilitating professional development meetings with colleagues was a predominant topic discussed by the participants. Jerry explains: “I knew after being in the PD academy for a while that this was going to be a different pedagogy and a different teaching style than I was used to…which I was totally open to trying but I also wanted to do my best, so I thought a good way to do that would be to invite other teachers to come in and observe me while I taught and then go and observe other teachers as well and their teaching style.” Elaine also describe how Jerry, Kramer, and herself lead a presentation on white boarding to colleagues: “we did an example of white boarding with the teachers as they are students at a faculty meeting.” As the participants indicate, contributions to PD of colleagues include: improving their own and others’ teaching abilities through means of self-reflection, sharing experiences and learning from others; encouraging classroom observations; leading by example; and conducting presentations to school, district, and administrative colleagues.

**Parent and community involvement.** As part of their goal of promoting PF to not just teacher colleagues but to parents and community, the participants utilized media, held an open
house, and wrote newsletters to ensure that parents were informed of the program. Jerry and Kramer describe that their goal was to inform and elicit student and community support and feedback for the program. Kramer describes; “myself and Jerry also felt it was necessary that the community knows what is going on in our 9th grade center. We took the opportunity to attend a media summit in our board office building to meet with the local media and ‘pitch’ our story to the news. Our local-news press took an interest in the story and visited our classrooms in action.”

**Participation in school change and improvement.** The participants also describe how they take part in the school/district decisions for implementing PF. For instance, Jerry commented: “the teacher that was the head teacher [science department head] is not going to be a part of the [PF] academy and so I thought it was probably in our best interest to have somebody as the head teacher who had been through the physics academy, so I expressed my interest to the principle and he then appointed me.” To enact new reform efforts, PF, the participants communicated to teacher colleagues and administration, promoted participation and collaboration among the science department and school. They also elicited and utilized feedback from peers and students through such tool as surveys or informal discussions, and held regular meetings with colleagues to discuss what was occurring in each other’s classrooms to improve each other’s pedagogy, curriculum, common assessments, etc.

**Coordination, management.** Unlike Kramer and Elaine, Jerry undertook the function of coordinator. Within his position as department head, he organized meeting times for regular departmental discussions, coordinated teacher training sessions, and purchased and oversaw the logistics of equipment.

**Social/Material/Cultural Resources**
Our results suggest there are eight resources that can influence teachers’ leadership pathways. These resources include social interactions, material resources, and/or cultural or environmental resources. The availability of these resources and how they are utilized can impact the paths of leadership taken and the overall leadership experience. Each resource is discussed below.

**Colleague support.** All the participants voiced that they were concerned about their colleagues supporting the new PF initiative. As Kramer describes: “one of my biggest concerns heading into the school year was addressing the possibility of teacher withdrawal, or teacher buy-in for the program. Unfortunately, this did become an issue with one of our science department members.” Each of the participants reported that in order to implement a new reform effort, PF, it was essential to have full colleague support. Not only is support from local school colleagues important, but support from colleagues in other school districts implementing PF was important as well. For Jerry: “I realized the importance of using your peers as a resource. We bounced some great ideas off of each other during our observation discussions.” Such communication and support from colleagues allowed for the exchange of ideas and advice (e.g. pedagogical practices and sharing of newly created assessments)

**Administrative support.** Administration support was also important for the success of implementing a new reform effort. Kramer states: “We got great backing from our administration which has been a huge reason why I think we have been successful in our school building.” Participants identified that administrators played a critical role for helping them acquire skills and knowledge necessary to implement PF, access free time, providing encouragement for conducting classroom observations, and obtain funding and equipment to support the PF
program. Also administrators’ verbal acknowledgements helped reinforce teachers’ leadership functions.

**Parent and student support.** Participants had initial concerns of parent and student apprehensions towards the implementation of the PF program thus potentially presenting additional challenges toward implementing PF. Yet, positive feedback from both parents and students further encouraged the teachers in their quest to implement school change.

**Time for professional development.** Time was an important resource for scheduling to help colleagues learn the PF curriculum and pedagogy or participate in peer classroom observations. Jerry describes: “time seems to be at the top of most teachers’ lists of challenges and I would say that I am no different.” The lack of time or difficulty finding common time to meet, however, can act as a barrier for successful leadership and fulfillment of leadership functions.

**Technology.** Access to technology such as online discussion board and blogs as part of the PD program aided teachers in fulfilling their action plans. As Kramer states: “the blogs are a great resource to read what has and hasn’t been working in other districts [implementing PF].” Such technology allowed the participants to easily communicate to those outside of their school for advice and sharing of resources.

**Professional development support – involvement in Physics First PD.** Participants recognized their experiences from the PD program cultivated their growth as a leader and the content knowledge gained created an essential resource to teach physics. Offering PD support to their fellow colleagues was also an important resource to help improve how PF and its curriculum is implemented within the school. Kramer explains: “one day a month for the first semester of the school year we train the other teachers in our building, that were science
Having the opportunity to offer or participate in PD helps teachers cultivate their abilities, develop the necessary knowledge and skills to become teacher leaders, and become lifelong learners.

**Collaborative/collegial environment.** A collaborative and collegial environment was described as an important resource for collectively facilitating their leadership action plans and taking risks as a leader. For instance, Elaine describes having an open door policy: “anybody is welcome to come to my classroom and look and see what I’m doing with my kids on a daily basis. Teachers that do, we sat down, probably on a weekly basis and talked about what they’ve seen in my classroom, what I’ve seen in their classroom, improvements, how we can then take what maybe they’ve done in the room and put in my class and vice versa.” Such a friendly environment allows for open dialogue with peers and administrators, developing common goals and visions, and successful collaborative experiences.

**Confidence/introspective.** A teacher’s confidence in themselves as a leader and in the educational reform program acts as an important resource to facilitate leadership. For Elaine: “I have grown more confident in my ability to share what I have been doing in my class with other teachers in my building because I have been able to do it one on one.” Not everyone is initially prepared to public share ideas, thus it is important to cultivate teachers’ confidence in themselves over time. Also, self-reflection and monitoring of their leadership is equally important to continually improve upon and evolve their leadership actions.

**Conclusion & Implications**

All teachers have the capacity to be leaders, through their efforts to bring about change in classrooms and schools (Barth, 2006). However, there is a recognized need to prepare and support individuals for teacher-leadership at the pre-service and in-service levels to build their
leadership capacity (York-Barr and Duke, 2004). With appropriate PD design and support, teachers can make difference as leaders. The principles of effective teacher professional development which proposed by Locks-Horsley and colleges (1998) explicitly address the importance of developing teacher leadership when designing a PD program. A PD project should aim on fostering teacher leaders for teacher development, curriculum, instruction, and assessment, and school improvement (Loucks-Horsley, Love, Stiles, Mundry & Hewson, 2003). The *Leadership in Freshman Physics* project focuses on developing teacher leaders and designing support for 9th grade physics teachers to successful implementation of the 'Physics First' (PF) curriculum. Thus, the purpose of this study was to explore and gain insight into how teachers (implementing PF for the first year) define teacher leadership, their experiences of assuming leadership roles/functions, and resources that may act as facilitators and/or barriers while implementing their action plan.

From this study, results suggest that leaders embody three characteristics as defined by the teachers – holding positions or conducting leadership activities, demonstrates knowledge and actions of leadership, and posses intrinsic qualities of leadership. The leadership roles or functions undertaken by these teachers include: professional development of colleagues, parent and community involvement, and participation in school change and improvement. These functions align with possible dimensions of leadership as defined by York-Barr and Duke (2004). The results of our case study with three teachers also suggest eight resources (social, material and cultural) that teachers have access to and how they are applied can influence the success of leadership functions undertaken. Further, how teachers define leadership may influence the functions they fulfill as a teacher leader and how they might utilize resources available in their environment. For instance, the teachers identified intrinsic qualities a leader
should possess, including confidence. In our analysis of what resources could influence success or present challenges for leadership an action, confidence again was a crucial resource that they relied upon. By having confidence in themselves, the teachers were able to take risks or necessary actions to fulfill their goals as leaders.

Our study provides the in-depth understanding on how PF teachers developed as leaders as well as the impact of a professional development program that included a focus on developing teacher leadership. Although the results of this study are limited to three teachers operating within a school implementing PF for the first year, the results underscore the need to further investigate paths of leadership within other contexts. By understanding how teachers view themselves as leaders, challenges or barriers they may face, identifying necessary resources, and the roles/functions of leadership they are to fulfill for the needs within their school, PD with an emphasis on teacher leadership can be appropriately designed.
References


