# TEACHER PERCEPTIONS OF CHANGE IN LEADERSHIP ROLES AND ACTIVITIES AS A RESULT OF PARTICIPATION IN A SCIENCE EDUCATION LEADERSHIP PROGRAM

A Dissertation

by

MARGARET PETTEY HOBSON

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2009

Major Subject: Educational Psychology

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August 2009

Major Subject: Educational Psychology

# ABSTRACT

Teacher Perceptions of Change in Leadership Roles and Activities as a Result of Participation in a Science Education Leadership Program. (August 2009)

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Teacher leadership has emerged as a component of the movement to increase student achievement in science and mathematics. The Information Technology in Science Center for Teaching and Learning (ITS Center) was funded by the National Science Foundation with the goal of developing science education leaders. This study explored the changes in teachers' descriptions of their leadership in their school settings before and after their participation in a science education leadership program and the aspects of their science education leadership.

A study of teacher-participants in Cohort II of the ITS Center was conducted to investigate how they demonstrated leadership in their school settings and to what extent these teachers attributed changes in their leadership to their ITS Center experience. Participants in this study were 15 classroom teachers who participated in Cohort II of the ITS Center.

Quantitative and qualitative methodologies were used. These teacher-participants completed a *Teacher Leadership Roles Survey* as a part of their application to participate

and then again one year after their ITS Center participation. Their primary leadership roles were to serve as a source of knowledge and a generator of new ideas for their fellow teachers. Their major activity was to develop curricular/instructional materials. However, the change in their leadership roles and activities was highly variable. As the literature indicates, demonstration of teacher leadership is highly dependent on context. The participants who greatly increased their leadership roles and activities moved into new, formal leadership roles following their ITS Center experience. Participants who greatly decreased their leadership roles and activities had changed school campuses or districts.

A case study was conducted of two teachers demonstrating a great increase in leadership. They identified the components of the ITS Center experience that contributed to increased leadership roles and activities as: relationships developed with fellow teachers, graduate students, and university faculty; extended time for engagement in ITS Center activities; accountability for implementation of ITS Center Instructional Frameworks and Practitioner Research Plan; and their increased understanding of educational research and the role it plays in evidence-based decision making.

# DEDICATION

This dissertation is dedicated to the memory of my parents John and Yula Pettey.

## ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Knight, and my committee members, Dr. Erlandson, Dr. Goetz, and Dr. Schielack, for their guidance and support throughout the course of this research.

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Finally, thanks to my daughter Genevieve and son Stephen for their encouragement and to my husband Bill for his patience and love.

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# CHAPTER I

## INTRODUCTION

"In the new global context, a scientifically literate population is vital to the democratic process, a healthy economy, and our quality of life" (National Science Board, 1998). This statement is one of many strident calls for an increasing scientific workforce and a scientifically literate population in the light of today's progressively more technological society. Although reasons range from maintaining national security and economic superiority of the United States to the quality of life for its citizens, there is a general consensus that science education is important and needs to be improved in the U.S. (Bush, 2006; Jackson, 2004; Lewis, 2006; National Academy of Sciences, 2005). The National Science Board (2003) states emphatically that "science and technology have been and will continue to be engines of U.S. economic growth and national security" (p. 1). The National Research Council's Committee on Harnessing Science and Technology for America's Economic Future (1999) further argues that effective use of science and technology is essential for sustained economic growth and improved living conditions. The Glenn Commission (Glenn & The National Commission on Mathematics and Science Teaching for the 21st Century, 2000) continues "from mathematics and the sciences will come the products, services, standard of living, and economic and military security that will sustain us at home and around the world" (p.4).

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This dissertation follows the style and format of the *American Educational Research Journal.*

For more than 20 years, there has been a movement to reform education, especially science and mathematics education, to prepare people for life in the 21st Century. *A Nation at Risk* warns of the "rising tide of mediocrity" (National Commission on Excellence in Education, 1983). Deficiencies in K-12 education are said to pose the most serious threat to this sustained economic growth and improved living conditions in the U.S. (National Research Council Office of Special Projects Policy Division, 1999). More recently, a committee of the National Academies of Sciences and Engineering and the Institute of Medicine (2005, p. 3) were challenged to identify the top 10 actions that federal policy makers could take to "enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century." Their first recommendation was to strengthen K-12 science and mathematics education. The 2005 National Assessment of Educational Progress (NAEP) found that only 30% of U.S. eighth graders scored at or above the proficient level in mathematics and 29% scored at or above proficient levels for science (National Center for Education Statistics, 2006). The National Academies of Science, Engineering, and Medicine (1998) recommends increasing America's talent pool for science, engineering, and medicine by "vastly improving K-12 science and mathematics education" (p. 6).

One of the primary mechanisms recommended to improve science education and science literacy in the U.S. is to "strengthen the skills of …teachers through training and education programs" (National Academy of Sciences, 2005, p. 5). The *No Child Left Behind* Act ("No Child Left Behind Act of 2001, Pub. L. No. 107-110," 2002) calls for

all teachers to be “highly qualified” which is defined as having a bachelor’s degree, being fully certified, and demonstrating competency in subject content. This requirement was based on research that demonstrates a direct relationship between teacher quality and student achievement (Ascher & Fruchter, 2001; Darling-Hammond, 2000; Ferguson, 1991; Goldhaber, 2002; Kaplan & Owings, 2003; Normore & Ilon, 2006; Sanders & Rivers, 1996; West & Woessmann, 2003; Wright, Horn, & Sanders, 1997).

## Teacher Quality

Since teacher quality has been shown to have direct relationship with student achievement, the next question is how to achieve teacher quality. There are four related mechanisms for improving teacher quality: (a) recruiting the best and brightest to teaching; (b) preparing teachers who have deep content knowledge, pedagogical content knowledge, and an understand of learning and pedagogy; (c) providing ongoing professional development to continue to improve and support quality teachers; and (d) retaining high quality, experienced teachers. Teacher leadership has been linked to each of these means and has emerged as a major component of the solution as a part of most national reform movements since 1983 (Barth, 2001).

### *Teacher Recruiting and Preparation*

In order to recruit the best and brightest to teaching, many solutions have been posited to overcome the barriers to initial recruitment to teaching. Two of the most common solutions are financial: raise teacher salaries and fund teacher preparation through programs such as the Robert Noyce Scholarship Program for science and

mathematics teachers administered by the National Science Foundation. Another more complicated solution is to change the culture and climate for teaching by professionalizing the occupation. The Carnegie Forum on Education (1986) and The Holmes Group (1986) advocated improvements to university course work that would enhance public perception of teacher preparation in general and colleges of education in particular. One of the enhancements is leadership development for preservice teachers. These groups also proposed that raising the standards for entering teacher education programs would improve public perception of teaching and, in turn, increase the number of students seeking teacher certification.

In response to the call to raise the standards for individuals entering science teaching, a variety of non-traditional mechanisms for recruiting and preparing science and mathematics teachers has arisen. On a national level, the Troops-to-Teachers program is a joint U.S. Department of Education and Department of Defense program to help eligible military personnel apply the knowledge and experience they gained in the military to the public school classroom as they transition into civilian life (Defense Activity for Non-traditional Education Support, nd). Also nationally, Teach for America, a program modeled after the Peace Corp, recruits recent college graduates to teach in inner city schools for up to three years (Teach for America Inc., 2009). Universities are creating programs to provide field-based public school classroom experiences for science and mathematics majors; two examples of this type of program are the Texas A&M Math and Science Scholars (MASS) program and the University of Texas at Austin UTeach program. Other non-traditional certification programs have

proliferated. Currently, in addition to the traditional university-based undergraduate program, Texas offers certification by examination for teachers holding certification in one content area seeking additional certification and certification through post-baccalaureate and alternative programs for individuals with college degrees seeking initial teacher certification, In 2006-2007(most recent data available) 2,016 individuals were certified to teach secondary (grades 8-12) science; 665 science teachers were certified through traditional programs, 755 teachers holding certificates in one content area received teaching certificates in secondary science by passing the Texas certification exam, 244 were certified through post-baccalaureate programs, and 352 science teachers were certified through alternative certification programs (Texas Education Agency & Texas Higher Education Coordinating Board, 2009). To put this in perspective, in 1999 17% of beginning Texas teachers were certified through non-traditional certification programs. By 2003, this percentage doubled to 34% (Herbert, 2004).

While this wide variety of certification tracks helps to address the quantity of certified science teachers, the quality of teachers is also a concern. As more professions such as medicine, law, and engineering have opened to women, the overall number and quality of people choosing to teach, especially women, is declining. For example, the National Science Foundation in their Science and Engineering Indicators (2006b) reports that college graduates who became teachers (both traditional and post-baccalaureate) took fewer rigorous academic courses in high school, had lower scores on 12$^{th}$-grade achievement tests, scored lower on college entrance examinations, and graduated from

less selective colleges than the average graduate. In Texas only 58% of secondary school students are taught by teachers who majored in their subject field (The Academy of Medicine Engineering and Science of Texas, 2009). While much research has been done on why people choose to become teachers, little has been done on people who do not choose to teach. Nonetheless, some of these studies found barriers that teachers faced when choosing to teach that include public perceptions of low teaching salaries (Goldhaber & Player, 2005), teaching as a poor career choice (Richardson & Watt, 2006), and unreasonable teacher workloads (Barmby, 2006).

*Teacher Development and Retention*

Teachers' years of experience has been found to relate to increased student achievement. For example, Ferguson (1991) collected data on more than 2.4 million students and 150,000 teachers in 887 school districts in Texas in the late 1980s. He found that teachers with more years of experience produced higher student test scores, lower dropout rates, and higher rates of taking the SAT. In primary grades, the statistically significant difference was between teachers with 0 to 4.99 years of experience and those with five or more years of experience. For secondary grades there was a statistically significant improvement in student achievement for teachers with five to nine years, and then more improvement for students whose teachers have nine or more years. This teacher experience accounted for 10% of the inter-district variation in test scores, a 4% improvement in dropout rates, and a 3% increase in the number of students taking the SAT.

This study, among others, points to the importance of retaining teachers at two points in their careers, induction and in later years. Retaining new or induction teachers is largely achieved through mentoring (Barnett, Gibson, & Black, 2003; Huling-Austin, 1992; Kersten, 2006). However, research-based programs to retain experienced teachers are more complex. In a meta-analysis of twenty quantitative studies, Billingsley (2004) found that job satisfaction is a major factor in teacher retention and accounts for the greatest difference between teachers intending to stay and those intending to leave. Wyman (2001) cites several studies that correlate teacher feelings of alienation and disenfranchisement with teacher attrition and correlate teacher roles in decision making and control (leadership) with teacher professionalism, satisfaction, and retention. Provasnik and Dorfman (2005) state from The Condition of Education NCES report that 52% of teachers transferring to another school and 42% of teachers leaving teaching entirely cited lack of influence over school policy as the reason for leaving. The Teacher Follow-up Survey in this same report also showed that 45% of leavers cited lack of opportunity for professional advancement as a reason for leaving.

Teacher leadership is seen as a means to increase teacher job satisfaction resulting in greater teacher retention and increased student achievement. As York-Barr and Duke (2004) argue, teacher leadership is a means

> to increase the status and rewards of teaching so as to attract and retain intellectually talented individuals, to promote teaching excellence through continued improvement, to validate teacher knowledge about effective

> educational practices, and to increase teacher participation in decision making about classroom and organizational issues (p. 256).

In the Study of Decision Making in High Schools, Weiss, Cambone, and Wyeth (1992) interviewed 180 staff members at 45 public high schools in 15 states. They found that when teachers are involved in leadership and decision making, they are more committed to the decisions. With this increased ownership, they are more likely to see that these decisions are implemented. When these decisions affect student learning, buy-in is critical.

Alvy (2005) recommends differentiated professional growth and developing career paths as means for retaining veteran teachers. In many school districts today, the only career path for teachers involves leaving the classroom. Barth (1999, p. 17) concluded that "when teachers lead, principals extend their own capacity. I think of teacher leadership as the act of having a positive influence on the school as well as within the classroom. Schools badly need leadership of teachers."

## Federal Programs for Teacher Leadership

Since *A Nation at Risk* (1983), the Carnegie Forum on Education (1986), the Holmes Group Reports (1995; 1990), and the U.S. Department of Education and the National Science Foundation have poured billions of federal dollars into developing teacher leaders, especially in science and mathematics. For example the one-year appropriation for the Eisenhower Professional Development Program in 1999 was $335 million (Porter, Garet, Desimone, & Birman, 2003) and from the beginning of the program in 1985 through 2000, more than $3 billion (U.S. Department of Education,

2003). The National Science Foundation (NSF) spent more than $700 million for systemic reform (statewide, urban, rural, and local systemic change). From 1981 through 1991, NSF designed and began development of a new generation of education and human resource programs. This decade of design and development became possible in large part because NSF funding for education increased from $26 million in 1982 to $465 million in 1992. The NSF education budget has expanded steadily; for example, it increased fivefold, from $92 million in 1986 to $465 million for 1992. From 1984 to 1989, NSF invested $160 million in more than 600 Teacher Enhancement projects, involving more than 63,000 science and mathematics teachers in all regions of the country. The Centers for Learning and Teaching program has awarded more than $185 million, and the Mathematics and Science Partnerships currently stand at more than $580 million awarded. While none of these programs were exclusively targeted at teacher leadership, all of them had a leadership development component. The present study will look at the teacher leadership development in one specific project under the National Science Foundation Centers for Learning and Teaching program.

**Information Technology in Science Center for Teaching and Learning**

Funded by the National Science Foundation in 2000, the Information Technology in Science Center for Teaching and Learning (ITS Center) had the goal of developing science education specialists through a program of study focused on the interaction between scientists, education researchers, and education practitioners. These science education specialists were expected to become leaders who would be responsible for the design and dissemination of quality professional development experiences structured

around the impact of information technologies on the teaching and learning of science. The project was designed to develop attributes in these science education specialists such as: (a) the capacity to use research-rich experiences in science education reform and professional development, (b) the ability to use research-based expertise in the application of information technology (IT) in exploring new ways of understanding complex physical systems, (c) expertise in the applications of IT in joint scientific and educational research and the integration of these enterprises into better professional development, and (d) an understanding of the importance of collaboration between specialists in scientific research and education in pursuing answers to the difficult questions of quality, access, and equity for **all** students in K-12 science education.

The ITS Center had three cohorts of participants: Cohort I from 2001-2003 (56 total participants, including 37 teachers), Cohort II from 2003-2005 (51 participants, 36 teachers), and Cohort III from 2005-2007 (59 participants, 39 teachers). After Cohort I, the ITS Center management team substantially re-structured the program and requirements. This new structure was used for both Cohorts II and III. Since Cohort I had a different experience than the later cohorts and Cohort III was completing their final year when this study began, this study examined only Cohort II participants. The participants included classroom teachers (teacher-participants), mentor teachers, state agency directors, school administrators, college instructors, and full-time graduate students. Participants began coursework during the first of two summer institutes (Summer 1) with a six credit-hour, three-week, intensive experience on the Texas A&M University campus as part of a science team. Cohort II science teams included:

- Deep Space and Deep Time in Plants: Sharing Research in Genomics and Cellular Imaging (Biology)
- Energy Equilibrium, Conservation, & Conversion in Material Science (Chemistry and Construction Science)
- Landscape Ecology and Conservation (Rangeland Ecology and Management)
- Molecular View of the Environment: Air, Land, and Water (Chemistry and Geology)
- Ocean Drilling Program: Understanding Earth's Natural Processes (Oceanography and Petroleum Engineering)
- Sustainable Coastal Margins (Geology, Civil Engineering, Biological and Agricultural Engineering, and Landscape Architecture)
- Visualizing Biodiversity (Wildlife Science, Geography, and Entomology)

During the first academic year after Summer 1, participants implemented the Instructional Frameworks they developed during the summer. This Instructional Framework, developed during the afternoon education course, was based on science content from each participant's project team and included (a) identification of a learning challenge, (b) scientific inquiry problem/question, (c) information technology applications, (d) assessments, (e), description of learning experiences with instructional technologies, and (f) strategic plan for implementation.

Successful implementation of these frameworks qualified participants to return for the second summer institute (Summer 2), which was another six credit-hour, three-week, intensive experience with the same science project team and education faculty. Participants continued to deepen and broaden science knowledge and skills with the project teams in the morning. In the afternoon *Classroom Action Research for Science Educators* course, participants refined or adapted their Instructional Frameworks and developed a classroom action research plan to study the impact of their Instructional Frameworks. These action research plans were implemented during the academic year following the second summer institute.

## Statement of the Problem

As noted above, the National Science Foundation (NSF), as well as numerous other federal, state, and local agencies and private foundations, have funded many different programs to develop science education leadership, and in particular science teacher leadership, over the past 40 years. In addition to the investment of money, a lot of time, both teachers' time and professional development providers' time, has been invested in programs to develop teacher leadership. Many of these programs, like the traditional university-based education leadership programs, have focused on developing leadership for educators moving to administrative or academia positions. However some programs, such as the ITS Center, have at least a portion of the effort that seeks to develop leadership of teachers remaining in the classroom. While individual project reports have provided evidence that participation in project activities does increase teacher leadership, little research has been done on identifying connections between the

characteristics of the leadership development programs, especially NSF-funded leadership programs, and the increases classroom teacher leadership (Haney, 2002).

## Purpose of the Study

The purpose of this study was to explore the changes in teachers' descriptions of their leadership in their school settings before and after their participation in a science education leadership program and the aspects of their science education leadership experience that selected teachers identify as contributing to their change in leadership.

## Research Questions

1. How do teachers describe their leadership roles and activities in their school settings before and after their participation in a science education leadership program?
2. Of the teachers who reported the greatest increase in their leadership roles and activities, what aspects of their science education leadership experience do they identify as contributing to their change?

## Design of the Study

This study used a sequential-explanatory design (Hanson, Creswell, Clark, Petska, & Creswell, 2005) mixed methods approach (Frechtling & Sharp, 1997; Johnson & Onwuegbuzie, 2004; Morgan, 1998). A sequential-explanatory design is used to explain "what happened" in a particular setting. The quantitative data are collected first, and informs the collection of the qualitative data which follows. Statistical analysis of quantitative data for all Cohort II teacher participants to answer Question 1 was followed by an in-depth qualitative multiple-case study of a purposive sample identified through the quantitative analysis to answer Question 2 (Stake, 1995; Yin, 2003).

Question 1 was answered using a survey designed by Smylie and Denny (1990) to explore teachers' leadership roles and activities as a result of participation in an urban school district's teacher leadership development program. This survey was a part of the ITS Center Cohort II application completed in the spring of 2003. As part of the follow-up evaluation, all Cohort II participants were requested to complete the survey again during fall 2006 and winter 2007, two and one-half (2 ½) years after participation in Summer 2 of Cohort II's ITS Center experience.

Question 2 was addressed through a case study that included interviews, field observations, and document analysis. A brief survey was completed by administrators to provide triangulation of data. Methodology is described in detail in Chapter III.

## Definitions

The following definitions of key terms will be used in this study:

*Participants.* For the purposes of this study, *participants* includes all people in Cohort II enrolled in the 12 credit-hour ITS Center science education specialist certification program.

*Teacher-Participants*. Secondary science and mathematics teachers in classroom settings from fall 2002 to spring 2005 who were participants in Cohort II of ITS Center Summer Institutes and completed at least the 12 credit-hour science education leadership certificate. These teachers may or may not have been pursuing a graduate degree.

*Science Education Specialist.* An educator with expertise in technology, teaching second-language students, and the assessment of science taught with

visualization and image technology (Ewing, Conoley, Denton, Newton, & Schielack, 1999, p. 4)

*Information Technology.* Technologies that include computational modeling, pattern visualization, digital libraries, and virtual environments, as well as electronic connectivity and communications to create a networked community of researchers, teachers, and learners (Ewing et al., 1999, p. 1).

*Instructional Technology.* Tools based in the delivery of educational material (National Science Foundation, 1998, p. v)

## Limitations

This study was conducted with a single cohort within one particular project. Teachers self-selected to apply and to participate in the ITS Center cohort, so no claim about the representativeness of these teachers for Texas or national science and mathematics teachers can be made. In fact, the application and selection process for participating in the ITS Center may have skewed the teacher participants to those exhibiting leadership or interested in developing leadership.

## Significance of the Study

Increasing scientific literacy is an imperative facing not only the U.S. but also the world in this time of increasing technology and a global economy (Bush, 2006; Friedman, 2005; National Academy of Sciences, 2005). Teacher quality has been found to play a critical role in student learning, and retention of highly qualified teachers in the classroom is critical (Normore & Ilon, 2006). Developing teacher leadership has the potential to increase the retention of these highly qualified teachers. However, little is

known about the essential characteristics of programs to develop teacher leadership. This study contributes to the knowledge base of how these programs impact classroom teachers and identifies some of the components of a program that contribute to leadership development.

# CHAPTER II

## LITERATURE REVIEW

> I know no administrator who doesn't need help in fulfilling this impossible job description.
>
> –Roland Barth

According to the *Oxford English Dictionary* (2006), the term "leadership" first appeared in 1821. However, defining, describing, and understanding leadership remains elusive (Neely, 2001). Cunningham (1985) found over 350 definitions of leadership in the literature. "Leadership is one of the most observed and least understood phenomena on earth" (Burns, 1978, p. 2). Describing, defining, and studying leadership in schools is no less problematic than in any other organization. In American schools, the need for leadership as a special function was recognized in the early nineteenth century. However, school leadership was not formalized or seen as a career path for teachers until the late nineteenth century (Mason, 2004). During the early twentieth century, this emerging school leadership structure was influenced by two competing management theories: Fredrick Taylor's scientific management theories which focused on efficiency and Mary Parker Follett's and Luther Gulick's human relations theory which was more aligned with John Dewey's progressive education (Glass, 2004).

These competing theories and others have complicated both the development and the study of school leadership at all levels. Donaldson (2001), reflecting on his 30 years in public education, said that a commonly heard theme is that schools, in general, have not been well led. Fullan (2001, p. vii), further stated that "at a time when leadership for

schools has never been so critical, there is also a growing shortage of people who are willing to take on the responsibility."

Greater attention has been paid to teachers' roles in school leadership in recent years. In the wave of school reform literature following *A Nation at Risk* (National Commission on Excellence in Education, 1983), teachers' preparation and roles, including teacher leadership, came into the national spotlight (Carnegie Forum on Education, 1986; The Holmes Group, 1986). Teacher leadership was highlighted by the National Academy of Science's *National Science Education Standards* (National Research Council, 1996, p. 72), which recommended that teachers become more involved with "collegial and collaborative learning…producing knowledge about teaching…becoming sources and facilitators of school change." Havens (1996, p. 1) noted that

> teachers are uniquely positioned for leadership in schools. Not only do teachers represent the second largest population, but they are in the unique position of being medially situated between students and administrators. Teachers are the link or bridge between policy and practice.

As a result of this increased attention, many efforts are being undertaken to understand the role of teacher leadership, especially in education change and reform (e.g., Heller & Firestone, 1994; Smylie, 1995; Suranna & Moss, 2002). This review of teacher leadership literature will examine two questions: What is teacher leadership? How is teacher leadership developed?

## What Is Teacher Leadership?

Educational reform literature emphasizes the importance of teacher leadership in serving our nation's schools. According to Wasley (1991, p. 138), this call for teacher leadership is "fueled by important and conclusive research conducted over the last 20 years that demonstrates that teachers, too long silent and isolated in the classrooms, must take more leadership in the restructuring of public education." The literature describing teacher leadership can be divided into four areas that must be examined in order to develop an understanding of what teacher leadership is: history of teacher leadership, definitions of teacher leadership, roles of teacher leaders, and characteristics of teacher leaders. The history of teacher leadership ties directly to definitions of teacher leadership. The various definitions of teacher leadership are important to understanding discussions of roles and characteristics of teacher leaders.

### *History of Teacher Leadership*

Although the concept of teachers taking an active role in school leadership dates back to at least 1916 in John Dewey's writings, the recent prominence of teacher leadership literature began with the educational reform movement of the 1980s (Rackley, 2004). Silva, Gimbert, and Nolan (2000) describe the recent history of teacher leadership as coming in three waves. In the first wave, teachers served in formal roles such as department heads, master teachers, and union representatives. Pellicer and Anderson (1995) align this wave of teacher leadership with the factory metaphor for schools. School leadership was bureaucratic with thinking and philosophy taken from scientific management principles. Tight supervision was the norm within the local

hierarchy. The main purpose of teacher leadership roles in this environment was to "further the efficiency of school operations" (York-Barr & Duke, 2004, p. 260). Teacher leaders were seen as an extension of traditional school administrations (Evans, 1996); this role was "designed [not] to change practice but to ensure the efficiency and effectiveness of the existing system" (Wasley, 1991, p. 4)

The second wave of teacher leadership "acknowledged the importance of teachers as instructional leaders" (Silva et al., 2000, p. 780) and arose from the education reform movement of the 1980s and much of the reform literature (Pellicer & Anderson, 1995). In this wave, teachers were leaders because of their instructional knowledge. They moved away from management into more pedagogical roles. Their roles were team leader, curriculum developer, professional development provider, and mentor of new teachers. Although this wave acknowledged teachers' pedagogical expertise, the roles were still "apart from" rather than "a part of" teachers' daily work (Wiggenton, 1992). Many times the teacher leaders did not work in the same building as the teachers being led, honoring the old maxim that "an expert is someone from 25 miles away." However, this lack of proximity hindered effective mentoring. Other teacher leaders in this wave were designated as "specialists" and were released at least part-time from the classroom. Smylie (1995) describes this as the most visible form of teacher leadership in recent efforts to professionalize teaching.

Although the third wave was defined in the 1980s (Lieberman, 1988), it is considered the "emerging" form of teacher leadership (York-Barr & Duke, 2004). Unlike the earlier waves, this wave views leadership as a part of teachers' day-to-day

work. This wave is described by Wasley (1991) as mentoring, problem solving, and providing professional growth for colleagues at the campus level. Teachers are viewed as leaders both within and outside their classrooms, and their leadership with colleagues outside the classroom is directly related to their work with students in the classroom (Ash & Persall, 2000). The goal of the third wave of teacher leadership is to "improve the quality of educational experience students receive while simultaneously working to retain and stretch top-quality people in the teaching profession" (Wasley, 1991, p. 5). Teacher leaders promote instructional improvements by re-creating a school culture that supports collaboration and continuous learning (Darling-Hammond, 1988; York-Barr & Duke, 2004).

*Definitions of Teacher Leadership*

As the history of teacher leadership has evolved, so have definitions of teacher leadership. Wasley (1991, p. 138) noted that "everyone in the educational community [has] a different interpretation of the teacher leader's role, the purpose, and how the time should be spent." Historically, teacher leadership definitions and research have often been related to general definitions and research on leadership. Although there are over 15,000 studies that deal with the broad topic of "leadership" (O'Hair & Reitzug, 1997), York-Barr and Duke (2004) found only 41 studies or reviews of studies relating to teacher leadership in the past twenty-five years. One of the problems they encountered while trying to synthesize this research is that it remains very difficult to arrive upon a consensus definition of "teacher leader" to serve as a base prescriptive for empirical studies. Wasley (1991) noted that it is growing more difficult to truly define teacher

leadership. From the research findings, the definition of teacher leader is still evolving and should be approached as an issue of organizational development. Many of the definitions relate to each of the three waves described above.

Definitions from the first wave of teacher leadership focus on teachers as managers (Evans, 1996). These teacher leaders were identified within the school hierarchy and had defined titles and roles such as department head, master teacher, or union representative. Paulu and Winters (1998) concluded that conventional definitions of teacher leadership focus on roles that can be assigned, are administrative in nature, and include activities related to directing, coordinating, and commanding.

The definitions of the second wave of teacher leadership more closely aligned with the classical definitions of leaders as individuals who "enable their colleagues to do things that they wouldn't ordinarily do on their own to improve their professional practice" (Wasley, 1991, p. 4). An example of a definition from this wave is "Career Professional," the highest of the three-tiered teacher licensing proposed by the Holmes Group (1986). These teachers are not only outstanding in the classroom, but they also show promise as teacher educators and analysts of teaching. Career ladders that emerged in the 1980s were a response to this view of teacher leadership. Like first-wave definitions, second-wave definitions tend to be hierarchical using terminology such as "career ladder." Smylie and Denny (1990) cite the 1987 paper by Devaney for the Carnegie Forum on Education and the Economy as a description of the second-wave Lead Teacher concept. In this view of teacher leadership, although Lead Teacher is a

designated role, specific responsibilities are flexible and vary to meet specific and changing needs at the local (campus) level.

Third-wave definitions do not focus on developing teacher leadership as an alternative track to the administration. Wasley (1992) found that teachers preferred collaborative teacher leadership to hierarchical leadership. Thus, in contrast to second-wave definitions, third-wave teachers are leaders when they function in professional learning communities to affect student learning, contribute to school improvement, inspire excellence in practice, and empower stakeholders to participate in educational improvement (Childs-Bowen, Moller, & Scrivner, 2000). Although there are few studies that provide systemic conceptual definitions of this type of teacher leadership, there are some commonalities across the studies. A teacher leader is one who provides support and motivation to other teachers, serves as a catalyst of other teachers' learning, is well-educated, and has several years of experience (Stone, Horejs, & Lomas, 1997). Crowther, Kaagen, Ferguson, and Hann (2002, p. xvii) further expand this definition as

> 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 the community….Teacher leadership facilitates principled action to achieve whole-school success. It applies the distinctive poser of teaching to shape meaning for children, youth and adults. And it contributes to long-term, enhanced quality of community life.

A central purpose of third-wave teacher leadership is to improve the teaching profession and assist in school reform (Smylie & Denny, 1990). "A teacher leader is one who can take his or her qualities, and share them with other teachers for the good of the students," according to Suranna and Moss (1999, p. 9). "The teacher leader is... a master teacher and curriculum leader, devoting talents to stimulating planning and implementation of curricular change," according to Andrew (1974, p. 5). Andrew additionally states that the term "teacher leadership" does not simply mean administrative or bureaucratic leadership; it is teachers promoting change which improves the quality of education. Andrew further proposes that the teacher leader serve as a bridge between the school and university as well as theory and practice. Formative Leadership Theory, developed by Ash and Persall (2000), is based on the belief that there are numerous leadership possibilities and many leaders within the school. Leadership is not role specific, reserved only for administrators; rather, the job of the school leader is to fashion learning opportunities for the faculty and staff so they can develop into productive leaders.

Fullan (1999) viewed teacher leaders as moral change agents; therefore, they require knowledge and skills related to the dynamics of the change process and must embrace the moral imperative to make a difference in the lives of children. Odell (1997) stated that it is an exercise of significant and responsible influence. Teacher leaders are "contributing to school reform or student learning (within or beyond the classroom), influencing others to improve their professional picture, or identifying with and contributing to a community of leaders" (Katzenmeyer & Moller, 1996, p. 5).

*Roles and Characteristics*

Much has been written on roles and characteristics of teacher leaders; however, to a great extent, the literature is purely descriptive rather than research-based, and most of the existing research is qualitative rather than quantitative. Teacher leadership roles depend on the wave and definition of teacher leadership. Odell (1997) states that roles have traditionally been formal and assigned, such as department chairs (first wave) or career ladders (second wave). Research by Hatfield, Blackman, Claypool, and Masters (as cited in Pellicer & Anderson, 1995) estimated that 10% to 20% of teachers are involved in formal (first- or second-wave) leadership roles. However, Odell (1997) and Magee (1999) identified two problems with formal teacher leadership roles: the roles are often undefined and holding a leadership role often leads to resentment by other teachers.

*Roles.* Today's teachers live in a society where job roles and responsibility are continually changing and expanding. Devaney (1987) described the more traditional teacher leader role as "lead teacher." She listed several roles including participation in school-level decision-making and leading inservice education (professional development). In some school reform efforts, school districts are creating new roles and new structures for teachers to become leaders. In writing about the importance of teacher leadership in meaningful school reform, Fessler and Ungaretti (1994) suggested that teacher leaders could be involved in preservice teacher education, mentor new teachers, research alternative courses of action in their classrooms, serve in leadership positions in professional organizations, provide professional development for teachers,

peer coach, and develop curriculum. The advisory committee of the SERVE Center at the University of North Carolina at Greensboro (1999) suggested that teachers are leaders when they contribute to school improvement and inspire excellence in practice. Teacher leaders also engage teachers, students, and community in public problem solving (O'Hair & Reitzug, 1997).

The importance of using a non-traditional approach to identifying and delegating responsibilities is being supported in the current research. In examining the principal's role in promoting teacher leadership, Childs-Bowen, Moller, and Scrivener (2000) stated that teacher leadership becomes a fluid role that extends beyond positional roles, such as department chair. They concluded that formal and informal roles become avenues for teachers to lead others.

The Formal Leadership Theory developed by Ash and Persall (2000) is based on the belief that there are numerous leadership possibilities and many leaders within the school. Leadership is not role specific, reserved only for administrators; rather, the job of the school leader is to fashion learning opportunities for teachers to develop into productive leaders. Various studies also supported this theory (Alvarado, 1997; Coyle, 1997) and indicated that effective teacher leadership involves a move away from top-down, hierarchical modes of functioning and a move toward more shared decision making. In other words, teachers must be willing to accept responsibility for factors beyond the classroom and be full partners in the school-based planning, decision making, and assessments (Clemson-Ingram & Fessler, 1997).

Empirical findings are as complicated as the history and definitions of teacher leadership. In a review of the literature on teacher leadership from 1980 to 2004, York-Barr and Duke (2004) found ten published empirical studies specific to the *roles* of teacher leaders. An extended search by this researcher which included presentations at the American Educational Research Association annual meetings identified four additional studies on teacher leadership roles during this time period. These 14 studies are detailed below and summarized in Table 2.1, which is modified from the table provided by York-Barr and Duke.

**Table 2.1**
**Teacher Leader Roles**

| Dimension of practice | Examples of supporting literature |
|---|---|
| Coordination, Management | • Coordinating daily schedules and special events (Ryan, 1999; Wasley, 1991)<br>• Participating in administrative meetings and tasks (LeBlanc & Shelton, 1997; Smylie & Denny, 1990; Suranna & Moss, 2000)<br>• Monitoring improvement efforts; handling disturbances (Heller & Firestone, 1995) |
| School or district curriculum work | • Defining outcomes and standards (Paulu & Winters, 1998)<br>• Selecting and developing curriculum (Acker-Hocevar & Touchton, 1999; Darling-Hammond, Bullmaster, & Cobb, 1995; Ryan, 1999) |
| Professional development of colleagues | • Mentoring other teachers (Acker-Hocevar & Touchton, 1999; Darling-Hammond et al., 1995; Devaney, 1987; Paulu & Winters, 1998; Ryan, 1999; Suranna & Moss, 2000)<br>• Leading workshops (Devaney, 1987; Smylie & Denny, 1990)<br>• Engaging in peer coaching (Devaney, 1987; Smylie & Denny, 1990)<br>• Modeling, demonstration teaching, encouraging |

Table 2.1 Continued

| Dimension of practice | Examples of supporting literature |
|---|---|
| | • professionals (Acker-Hocevar & Touchton, 1999; Silva et al., 2000; Smylie & Denny, 1990) |
| Participation in school change/improvement | • Taking part in school-wide decisions (Acker-Hocevar & Touchton, 1999; Marks & Louis, 1997; Paulu & Winters, 1998; Ryan, 1999)<br>• Working with peers for school change (Darling-Hammond et al., 1995; Heller & Firestone, 1995; Silva et al., 2000; Suranna & Moss, 1999)<br>• Facilitating teacher learning communities as an organization wide processes (Crowther et al., 2002)<br>• Participating in research, especially action research (Darling-Hammond et al., 1995)<br>• Confronting barriers and challenging the status quo in the school's culture and structure (Crowther et al., 2002; Silva et al., 2000; Suranna & Moss, 1999, 2002) |
| Parent and community involvement | • Becoming involved with parents; encouraging parent participation (Paulu & Winters, 1998)<br>• Creating partnerships with community businesses (Paulu & Winters, 1998)<br>• Working with the community and community organizations (Crowther et al., 2002; Paulu & Winters, 1998) |
| Contributions to the profession | • Participating in professional organizations (Paulu & Winters, 1998)<br>• Becoming politically involved (Paulu & Winters, 1998) |
| Preservice teacher education | • Building partnerships with colleges and universities to prepare future teachers (Darling-Hammond et al., 1995; Paulu & Winters, 1998) |

Smylie and Denny (1990) researched primarily second-wave teacher leadership in a metropolitan K-8 school district. Teacher leaders were formally appointed or, as they termed it, *anointed*. However, roles and responsibilities in this district were not

prescribed; each campus and teacher leader had the flexibility to define the role to meet local leadership needs, a situation which in some cases aligned with the definition of third-wave teacher leadership. These teachers performed leadership roles *in addition to* their regular classroom duties. Even with this open-ended description, teacher leaders consistently defined their roles in terms of helping and supporting teachers on their campuses. Smylie and Denny used a multistage interactive method of data collection, analysis, and interpretation to develop these surveys. They first conducted open-ended interviews with teacher leaders asking them how they defined their roles as leaders, what leadership activities they engaged in, and what factors influenced their leadership. These data were analyzed using a comparative method (Glasser & Strauss, 1967) to identify themes and patterns. These themes and patterns were then discussed with district-level school personnel not directly involved with the teacher leadership program. After this discussion, themes and patterns were codified and developed into Likert-type surveys that were administered to each of the teacher leaders. This was the only study of the 14 identified that used the results of qualitative (case study) research to create a quantitative instrument.

The teachers in this study identified eight teacher leadership roles: facilitator/enabler, helper for teachers, catalyst for individual improvement, generator of new ideas, source of emotional support for teachers, administrator of programs and policies, and evaluator of other teachers. However, when Smylie and Denny (1990) asked the teachers how they spent their time as leaders, the leadership activities did not match the teachers' perceptions of their leadership roles. The eight leadership activities

were: attend (participate in) program-related meetings; engage in building-level decision making related to curricular, instructional, and professional development planning; develop district-level curricular programs; develop curricular/instructional materials; plan building-level staff development activities; develop building-level curricular/instructional programs; meet with principal to discuss principal's concerns and plans for building; and promote implementation of district-level programs. The teachers' perception of their primary role as teacher leaders was to provide classroom-level support while the activity that consumed most of the teacher leaders' time was participating in building-level meetings and administrative work.

Wasley (1991) conducted an in-depth case study of three teacher leaders from different geographical regions of the United States. Two of the teachers were formally designated as leaders by the school administration while the third was recognized by peers as a leader but not formally appointed. All three teachers had both instructional and administrative roles, with the formally designated teachers spending more time on administrative tasks.

Darling-Hammond, Bullmaster, and Cobb (1995) examined teacher leadership in seven professional development schools (PDS). The PDS were collaborations between universities and K-12 schools to support the learning of preservice and inservice teachers while restructuring the K-12 schools and the colleges of education. Teacher leadership in these schools was widely diffused and developed over time rather than being defined by formal roles or positions. Case studies revealed two of the primary roles of these teacher leaders were mentoring fellow inservice teachers and supporting and preparing

preservice teachers. They also served as curriculum developers and decision makers. They solved problems and became change agents on their local campuses. Finally, they were engaged in research both with university faculty and independently in their own classrooms and school buildings.

Heller and Firestone (1995) studied leadership roles as a source for planned school change. Their sample included eight schools that had varying success in implementing Elias's and Clabby's Social Problem Solving program (1989). They defined leadership in terms of tasks to be performed rather than as a role. They found that the primary tasks performed by teacher leaders included sustaining and continuing to promote the vision for reform, monitoring improvement efforts by encouraging each other and initiating newcomers into the program, handling disturbances by providing advice and feedback to peers on dealing with problems, and working with peers for school change through both formalized and informal means.

Five teacher leaders from South Florida were interviewed by LeBlanc and Shelton (1997) to examine the teachers' perceptions of themselves and others while they worked in their leadership roles. The teachers reported that they were most effective as leaders when they collaborated with administrators and fellow teachers. This collaboration occurred both in formal committee meetings and in more informal mentoring-type collaborations with other teachers.

Marks and Louis (1997) looked at teacher leadership in terms of teacher empowerment defined as participation in school decision making. They examined data from 24 public elementary, middle, and high schools selected through a national search

based on criteria developed to measure each school's restructuring in leadership, management, and governance. Data collected included questionnaires completed by 910 teachers, classroom observations, interviews with school personnel, observation of governance and professional meetings, two student assessment tasks, and student work samples. In addition to using an unconditional HLM model as a one-way analysis of variance with random effects to estimate the within and between school variance, they used "correlational analyses at the school and classroom levels to summarize the relationships among students' academic performance, authentic pedagogy, empowerment, professional community, and responsibility for student learning" (Marks & Louis, 1997, p. 254). They found that when teacher empowerment results in a stronger professional community, greater collective responsibility for student learning, and more authentic pedagogy, there is a strong, positive effect on standardized student achievement.

The U.S. Department of Education brought together 120 exemplary public and private school teachers to answer questions about teacher leadership (Paulu & Winters, 1998). This 1996 National Teachers Forum was the fourth such forum hosted by the U.S. Department of Education. Teachers were asked to discuss why teacher leadership is needed, what forms teacher leadership can take, how teachers can become leaders, and how teacher leadership can be supported. Paulu and Winters (1998) used participant responses to identify teacher leadership roles; these roles are summarized in Table 2.2.

**Table 2.2**
**National Teacher Forum Leadership Roles**

| Role | Example |
|---|---|
| Participating in professional organizations | Union representative or organization office holder |
| Taking part in school decisions | Site-based management teams |
| Defining what students need to know and be able to do | Serving on standards committees |
| Sharing ideas with colleagues | Develop and lead professional development |
| Mentoring new teachers | Formal programs to support novice teachers |
| Helping to make personnel decisions | Hiring committees |
| Improving facilities and technology | Seeking external funding |
| Working with parents | Leading programs for parental involvement |
| Creating partnerships with the community, businesses, and universities | Recruiting and coordinating volunteers, Adopt-a-school activities, and preservice teacher preparation |

Ryan (1999) conducted a multi-site case study of 12 teacher leaders to examine the impact of teacher leadership and to explore conditions that support or hinder effective teacher leadership. Ryan found that teacher leaders served as a resource for fellow teachers in instructional practice, dealing with difficult students, and planning instruction. They also influenced school policies in ways that increased opportunities for student learning. They served in decision making roles for curriculum issues and schedules.

In a broader study of decision making structures, Acker-Hocevar and Touchton (1999) described formally recognized teacher leaders as networkers able to see the big picture. The six teachers they studied were able to make decisions that affected curriculum and instruction on their campuses. They played a role in mentoring other teachers and sought to make a difference and have an impact in their schools.

Suranna and Moss conducted a series of case studies to examine teacher leadership from the viewpoint of preservice teachers (1999), beginning teachers (2002), and experienced teachers (2000). They found that preservice and novice teachers believe that a major role of the teacher leader is taking a stand, going against the grain, standing up for what you believe, and challenging convention. Half of the experienced teachers were unfamiliar with the term *teacher leadership*, and many were hesitant to discuss teacher leadership roles because the term did not have a standard definition. However, after researchers assured the teachers that the study was interested in their personal views, most teachers were able to answer the interview questions. Four themes emerged: professional development, great teaching, taking a stand, and facilitators and hindrances.

Silvia, Gimbert, and Nolan (2000) conducted a descriptive case study on third-wave teacher leaders in a school district that claimed to provide significant professional development opportunities for teachers. These teachers had two primary roles. First they supported, mentored, and encouraged fellow teachers. Their second role was to work for change. In working for change they both challenged the status quo and learned how to navigate school administrative structures in order to generate support for change.

The book on developing teacher leaders by Crowther, Kaagan, Ferguson, and Hann (2002) is based on a five-year, three-phase study in Australia with links to Michigan. The first two phases were conducted in Queensland, Australia. The third phase was Australia-wide. Phases two and three were subject to external validation by educational groups in Michigan with guidance by Professor Steve Kaagan of Michigan State University. The purpose of their work was to examine teacher leaders whose work had made a difference in schools and communities. Phase one (Crowther & Olsen, 1997, p. 6) research questions were:

> What characteristics distinguish the work of sample educators who have achieved success in working in socioeconomically disadvantaged schools?
>
> What forms of educational leadership are inherent in these characteristics?

Criteria were developed to identify 15 school-based practitioners, 13 teachers and two paraprofessionals. Written descriptions of specific situations, on-site interviews, and focus group sessions were used to collect data. A three-stage approach was used to analyze this data. First, a profile was developed for each participant. Then the data were quantified in terms of disadvantage, educational strategies used, and leadership. Finally, findings were member-checked with the participants. Details of methodology for phases two and three were not described.

They found that teacher leaders participated in school improvement by facilitating teacher learning communities throughout the school organization. These teacher leaders, like those in the study of Silva et al. (2000), confronted barriers and

challenge the status quo to enhance student learning. They translated ideas into action by building partnerships with both school administration and the community at large.

*Characteristics.* Empirical studies and theoretical literature are fairly consistent about the broad characteristics of teacher leaders. These characteristics can be divided into two categories: as teachers and as leaders. Strodl (1992, p. 4) cites Gardner's view of these categories as having equal importance: "Teaching and leading are indistinguishable occupations, but every great leader is teaching and every great teacher is leading." Rogus (1988a) described four overriding teacher leader characteristics, (a) self development, (b) vision, (c) empowerment, and (d) trust. A common theme that emerged was that in order for teachers to serve as leaders outside the classroom, especially in gaining allies among colleagues, they must be outstanding teachers in the classroom and respected by their peers (Acker-Hocevar & Touchton, 1999; Little, 1988; Suranna & Moss, 1999). Teacher leaders also value lifelong learning and seek opportunities for personal growth (Barth, 1999; LeBlanc & Shelton, 1997; Wilson, 1993).

Most teacher leaders have significant teaching experience, especially in their teaching fields on their local school campus, and are viewed as having excellent teaching skills (Fullan, 1994; Katzenmeyer & Moller, 1996; Lieberman, 1988; Lieberman, Saxl, & Miles, 1988; Ryan, 1999; Sherrill, 1999; Suranna & Moss, 2000). Their philosophy of education is well developed and articulated. Teacher leaders not only have extensive knowledge about their content area, they also have deep knowledge about teaching, learning, and curriculum development (Lieberman et al., 1988; Sherrill, 1999; Yarger &

Lee, 1994). These teachers are creative and able to motivate students by using a variety of strategies (Wilson, 1993). They are passionate about teaching and student success (Yarger & Lee, 1994) and assume personal responsibility for their students' achievement (Crowther et al., 2002; Marks & Louis, 1999). Since many of the second- and third-wave teacher leaders assume leadership *in addition to* classroom responsibilities, they are able to manage a heavy workload because of their strong administrative and organizational skills (Lieberman et al., 1988; Wilson, 1993).

As leaders, teachers have a deep understanding of the school as an organization and are able to view the big picture and broader impact of decisions (Acker-Hocevar & Touchton, 1999; Lieberman et al., 1988). They are able to build trust with colleagues, work collaboratively, and impact the school through the relationships they develop (LeBlanc & Shelton, 1997; Lieberman et al., 1988; Sherrill, 1999). O'Hair and Reitzug (1997, p. 68) in a review of several research studies concluded that teacher leaders promote a set of "ideals that include inquiry, discourse, equity, authenticity, shared leadership, and service" which promotes examination of school practices and ways to improve them. They further reported that teacher leaders engage others in looking for ways to solve problems and make decisions regarding school practices. Yarger and Lee (1994) described six interpersonal skills, which are well-developed in teacher leaders (a) effective written and oral communication, (b) good listening ability, (c) good group processing, (d) good ability to mediate, (e) good skill in negotiation, and (f) cultural sophistication.

Since one of a teacher leader's roles is confronting barriers and challenging the status quo in the school's culture and structure (Crowther et al., 2002; Silva et al., 2000; Suranna & Moss, 1999, 2002), the ability to handle conflict, negotiate, and mediate is an important skill (Weiss et al., 1992), as is the ability to understand and prioritize concerns of all the stakeholders (Sherrill, 1999). At the same time, they are supportive of their colleagues, sensitive and receptive to thoughts and feelings of others, and able to promote professional growth in others (Lieberman et al., 1988; Wilson, 1993; Yarger & Lee, 1994).

*Summary*

The definition of teacher leader is still evolving and should be approached as an issue of organizational development. An informal poll of educators seeking a definition of teacher leaders produces results similar to Justice Potter Stewart's famous 1964 non-definition of pornography, "I know it when I see it" ("Jacobellis v. Ohio," 1964). Many of the definitions relate to each of the three waves described above. Definitions from the first wave of teacher leadership focus on teachers as hierarchical managers, while definitions from the second wave more closely align with the classical definitions of leaders as individuals who "enable their colleagues to do things that they wouldn't ordinarily do on their own to improve their professional practice." Like first-wave definitions, second-wave definitions tend to be hierarchical, using terminology such as "career ladder." Third-wave definitions do not focus on developing teacher leadership as an alternative track to the administration. Third-wave teachers are leaders when they function in professional learning communities to affect student learning, contribute to

school improvement, inspire excellence in practice, and empower stakeholders to participate in educational improvement.

Much has been written on roles and characteristics of teacher leaders; however to a great extent the literature describes leadership rather than reports research, and most of the existing research is qualitative rather than quantitative. The identified roles include coordination and/or management, school or district curriculum work, professional development of colleagues, participation in school change or improvement, parent and community involvement, contributions to the profession, and preservice teacher education.

## How Is Teacher Leadership Developed?

If schools are indeed professional communities in which every teacher takes collective responsibility for helping all students learn (Marks & Louis, 1999), professional development must prepare teachers for this responsibility through leadership development, and school culture and climate must support the conditions necessary to make teacher leadership effective. Often this involves change both at the individual level and at the system level. Since the present study focuses on the impact of a particular professional development program on individual teachers, the change discussed in this review of the literature will focus on the professional development literature dealing with effective professional development as it relates to change and professional development programs specifically targeted for teacher leadership. Smylie and Denny (1990) argued that teacher leadership should be approached as an issue of organizational change and not merely as a task of enhancing individual opportunity and

performance. Since Research Question 1 looks at what the teacher leaders do in their current environment, literature on the culture and climate that either supports teacher leadership or erects barriers to it are briefly reviewed.

*Professional Development for Teacher Leadership*

*Change theories.* Most of the change theory literature deals with organizational change. However, some portions of these theories can be applied to individual change. Rogers's (1995) Diffusion of Innovations model focuses on the change (innovation) itself. Rogers contends that "much effort has been spent in studying *people* differences in innovations…but that relatively little effort has been devoted to analyzing *innovation* differences…" (p.204). Rogers' framework includes five perceived attributes of innovations that impact the rate of adoption:

- Relative advantage ("Is it better than what I am doing now?")
- Compatibility ("Does it conflict with my current role?")
- Complexity ("Is it too complicated to do in my current setting?")
- Trialability ("Can I try it out and go back to what I was doing if it doesn't work out?")
- Observability ("Can I watch or learn about someone else doing it before I try it?")

Rogers' change theory could be important to understanding the leadership roles that teacher leaders adopt in their school settings. In his *indigenous knowledge systems*, the shared understanding of members of the (school) environment also relate to the culture

and climate that support teacher leadership and the barriers that inhibit teacher leadership.

Ely's Conditions of Change model focuses on the environment in which the changes occur and describes eight conditions that facilitate the implementation of educational technology innovations. Ely (1990) first published his eight conditions for change in a report of his Fulbright research study conducted in Indonesia, Chile, and Peru between January and June 1989 to identify the status of educational technology in primarily formal education settings in each country. These conditions have since been confirmed by other studies (Ely, 1999) and have been found to have broader implications for educational change (Ellsworth, 2000). Ely's eight conditions are: (a) dissatisfaction with the status quo, (b) existence of knowledge and skills, (c) ability of resources, (d), availability of time, (e) rewards or incentives, (f) participation, (g) commitment, and (h) leadership. These conditions for change relate more to the culture and barriers than to the change in individuals and will be discussed below.

Fullan's name is nearly synonymous with educational change. His Meaning of Educational Change model (1982) focuses heavily on the people taking part in the change process. Fullan identifies teachers as the first and one of the most critical of six types of stakeholders that serve as change agents at the local level. He asserts that "educational change depends on what teachers do and think—it's as simple and complex as that" (1982, p. 107). In the second edition, Fullan, along with Stiegelbauer, further argues, "If educational change is to happen, it will require that teachers understand themselves and be understood by others" (1991, p. 117). In choosing to adopt a change,

such as assuming a new leadership role, Fullan and Stiegelbauer conclude that research shows that teachers use four criteria (1991, pp. 127-128). First, does the change address a need? Second, are the requirements clear in terms of what the teacher will need to do? Third, how will the change affect the teacher in terms of time, energy, new skills, and interference with existing priorities? Finally, how rewarding will it be in terms of interacting with colleagues and others?

The Concerns-Based Adoption Model (CBAM) has had numerous contributors since it was originally proposed by Hall, Wallace, and Dossett (1973). The elements of this model that are most relevant to the development (change) of leadership roles in teachers are the Stages of Concern and the Levels of Use (Hall & Hord, 2006). Stages of Concern begin at 0: Awareness and proceed through 1: Informational, 2: Personal, 3: Management, 4: Consequence, 5: Collaboration to 6: Refocusing. Stages of Concern were developed from the research on feelings and perceptions about change. Levels of Use were identified and verified through the CBAM teams' research on how people act or behave during change (Hall & Hord, 2006). The first three Levels of Use are really nonusers, defined as those getting ready to use an innovation or in the present case, assume a leadership role. These levels are 0: Non-use, I: Orientation, and II: Preparation. The remaining five levels are descriptions of people as they implement change: III: Mechanical Use, IVA: Routine Use, IVB: Refinement, V: Integration, and VI: Renewal.

*Teacher change*. Lasting change in teacher practice, including leadership practices, requires more than increasing teacher knowledge and skills (Guskey, 1986).

In the past 15 years, many studies have indicated that teacher beliefs have as much or more impact as knowledge and skills have on teacher actions (Brickhouse, 1990; Bryan & Abell, 1999; Luft, 2001). In fact, Lumpe, Haney, and Czerniak (2000) found that teachers' beliefs may be the best indicators of teachers' professional decisions and that these beliefs are the agents of lasting change. Lumpe and Chambers (2001) further found that teacher beliefs in general and self-efficacy beliefs in particular were significant predictors of teacher adoption of new practices. However, according to Guskey (1986) the literature is divided on what happens first. Does teacher belief have to precede change in practice, or does a successful attempt at changing practice change teacher belief? Fullan and Stiegelbauer (1991) argue that behavior (change) initially precedes belief, and that this relationship is ongoing and reciprocal. What are not equivocal are the characteristics of professional development that support this change.

*Research on effective professional development.* Professional development is defined by researchers as experiences designed to provide new knowledge for professionals, such as teachers, to broaden their knowledge base, improve practice and/or change beliefs (Guskey, 1986; Loucks-Horsley, Hewson, Love, & Stiles, 1998). Loucks-Horsley et al. (1998) synthesized much of the current research on effective professional development in the first edition of their book *Designing Professional Development for Teachers of Science and Mathematics*. In this work, they outline 18 formats for effective professional development including immersion in inquiry into science and mathematics; immersion in the world of scientists and mathematicians; curriculum implementation; curriculum replacement units; curriculum development and

adaptation; workshops, institutes, courses, and seminars (traditional models); action research; case discussions; study groups; examining student work and student thinking; coaching and mentoring; partnerships with scientists and mathematicians; professional networks; developing professional developers; and technology for professional learning.

Subsequent research has found that the *format* of the professional development is not as important as the active engagement of the teachers, the duration of the experience, and accountability for implementation (Chappelle & Eubanks, 2001; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). Garet et al. ("No Child Left Behind Act of 2001, Pub. L. No. 107-110," 2002) conducted a nationwide study of 1,027 science and mathematics teachers to identify features of professional development that have significant positive effects on not only teacher knowledge and skills but on teacher practice. They found that effective professional development focuses on content knowledge, provides active learning, and is coherent with other experiences and expectations that teachers have. Darling-Hammond and McLaughlin (1995) identified six characteristics of effective professional development that apply to preparing teacher leaders.

1. It must engage teachers in concrete tasks of teaching, assessment, observation, and reflection that illuminate the processes of learning and development.
2. It must be grounded in inquiry, reflection, and experimentation that are participant driven.
3. It must be collaborative, involving a sharing of knowledge among educators and a focus on teachers' communities of practice rather than on individual teachers.

4. It must be connected to and derived from teachers' work with their own students.
5. It must be sustained, on-going, intensive, and supported by modeling, coaching, and the collective solving of specific problems of practice.
6. It must be connected to other aspects of school change.

*Teacher leadership development content frameworks*. Rogus (1988b) and Sherrill (1999) each developed a theoretical framework for content of teacher leadership professional development. Both frameworks are based on teacher leadership research and "wisdom of practice" (Rogus, 1988b, p. 50). The frameworks are described in terms of outcomes or expectations for teacher leaders.

Rogus (1988b) based his outcomes on the competency categories of effective leaders proposed by Bennis and Nanus (1985): self-deployment, empowerment, vision, communicating the vision, and positioning. Under these five categories, Rogus proposed more than thirty outcomes in his sample frameworks for a teacher leader program. York-Barr and Duke (2004) summarized these outcomes as including: demonstrating skills of effective instruction, demonstrating an inquiry orientation to teaching, working with others, creating community, leading curriculum review, articulating and communicating vision, fostering political support for change, and demonstrating patience and persistence.

Sherrill's framework (1999) proposed leadership development expectations for three phases of the teacher professional continuum: teacher preparation, induction, and ongoing professional development. All three phases included a common set of core expectations: demonstrating exemplary instruction, understanding theories of adult

learning, demonstrating knowledge of clinical supervision models, cultivating desired dispositions in teachers, guiding colleagues by a reflective and inquiry-oriented posture, and possessing research-based knowledge about teaching and learning. In addition to the core competencies, through ongoing professional development experienced teachers should develop the ability to assess and prioritize district and teacher needs. They should know how to positively affect the school culture. Professional development for these teachers would help them understand and conduct action research and practice-centered inquiry as they learn to expand and improve their colleagues' teaching methods. This professional development should also provide teacher leaders with the skills to facilitate effective professional development for others.

Katzenmeyer and Moller (1996) formulated their framework for teacher leadership development from their ten-year professional development collaboration on applying the research and knowledge on school reform, effective professional development, and teacher leadership. Unlike the frameworks of Rogus and Sherrill, this model begins with the identification of teachers with leadership potential. The three criteria they recommend to assist in identifying leadership readiness are competence, credibility, and approachability. They have developed a leadership readiness assessment tool which is included in the second edition of their book (Katzenmeyer & Moller, 2001). The leadership development model is built around four questions: "Who am I?" (understanding self); "Where am I?" (understanding school environment); "How can I lead?" (developing leadership skills); and "What do I do?" (applying leadership in the school environment).

In reviewing these frameworks, York-Barr and Duke (2004) cited the study conducted by Dierks, Dillard, McElliot, Morgan, Schultz, Tipps, and Walentine that interviewed teachers about their needs for leadership development. They found that content needs identified by these teachers were more organizationally focused than those described by Rogus and Sherrill. The topics teachers identified were those found in more traditional educational administration programs including school finance and budget, school law, multicultural education, change processes, and participatory decision making.

*Teacher leadership development programs*. There are many programs with the goal of developing leadership in teachers in many formats and contexts. One paradigm is the professional development school which partners a university teacher education program with a local school or district. The programs at Johns Hopkins University (Clemson-Ingram & Fessler, 1997) and Fairleigh Dickenson University (Forster, 1997) are two such programs. These professional development schools "redefine teacher preparation and professional development as a continuum of learning and personal growth for preservice, new, and veteran teachers" (Forster, 1997, p. 89) and seek to develop teacher leadership at all levels.

A second type of teacher leadership development program is the state education agency or school district-based plans. These programs tend to develop specific individuals for identified roles that meet a local need. The Douglas County School District in Colorado developed building resource teachers (BRTs) to serve as campus-level mentors, coaches, consultants, and resources for teachers, principals, parents, and

paraprofessionals (Hayes, Grippe, & Hall, 1999). Success of this program is attributed to a sustained, supported plan with clearly defined roles for the teacher leaders. The elementary laboratory school at the University of California, Los Angeles designed a program to develop teacher leaders to provide support for teachers who were working to improve their teaching and student learning (Williams, Kirst, & Haertel, 2005). Research on this program indicated that the following recommendations would support replication in other schools: (a) select leader roles that meet the greatest need; (b) choose teacher leaders with credible expertise and leadership skills; (c) clarify the leader role early on; (d) have teacher leaders spend the majority of their time in the classroom with other teachers; (e) focus on student learning; and (f) ensure that the principal supports the leader. The Austin Independent School District began a Teacher Leadership Development Program to build teachers to serve in roles such as master teacher, instructional team leader, curriculum planner, teacher specialist, or department chair (Westbrook, 2001). Westbrook found that teachers in this program were able to move beyond traditional roles of leadership through reducing isolation and opening practice to discussion, analysis, and criticism.

A third type of teacher leadership development program is the special purpose leadership program funded by a private foundation or a state or federal agency. The U.S. Department of Education through block grants to state education agencies and the National Science Foundation (NSF) through merit-review teacher enhancement grants to universities have long funded this type of leadership development program. Most of these programs are specifically targeted to leadership in a particular content area such as

science, mathematics, or technology. As the National Science Foundation acknowledges in their new solicitation for the Discovery Research K-12 program, evaluations of effectiveness and impact of these programs have been "short term in nature, …done by or under the auspices of the grantee, and…generally focused mostly on formative issues" (2006a, p. 7). However, a few studies of such programs have been conducted.

Erb (1997) looked at the impact of a state-funded Technology Teacher Leadership Corps professional development program. Erb found that participants had an increased knowledge, skill, and use of technology in their own classrooms. This resulted in many of the teachers taking a leadership role on school or district technology committees and leading technology integration into the curriculum. They were viewed as experts by colleagues and served in both informal and formal leadership roles. Participants' leadership resulted from their participation in a formal leadership program and from their own expertise in the classroom.

Martinez (2000) examined how teacher leadership was encouraged through participation in the NSF-funded science education professional development program *Microcosmos*. The program focused on microbiology for middle school and high school grades. Martinez found that as a result of participating in the Microcosmos program, teachers considered "the concept of sharing knowledge with colleagues to be a major quality of teacher leadership" (2000, p. vii). Lifelong learning and having vision were other leadership attributes identified by the participants. The six attributes of Microcosmos that he found to influence the development of teacher leadership were: (a) selection of teacher participants based on leadership potential; (b) provision of a

curriculum that teacher participants saw as having educational merit; (c) provision of material that is applicable to teacher participants' school setting; (d) presentation of models for methods and strategies for applications; (e) development of teacher participants' emotional commitment to the program; and (f) preparation of teacher participants for specific leadership roles.

*Culture and Climate for Teacher Leadership*

No matter which type of leadership development a teacher participates in, teacher leadership roles and activities are impacted by the teacher leader's professional environment. An examination of teachers assuming a leadership role and performing the leadership job involves a closer look at the school culture and organizational dynamics. Smylie and Denny (1990) suggested that the performance (roles) of teacher leaders may be influenced substantially by the organizational structure, especially time and space. Lieberman, Saxl, and Miles (2000) noted that experienced teacher leaders identified school climate and the administrator's style as the two most critical components of the school culture. Research findings from Smylie and Brownlee-Conyers (1992) suggested that the development of new working relationships between teacher leaders and their principals is a complex and complicated matter. Often the interactions between teacher leaders and school personnel have important implications for leadership roles. Little (2000) argued that the greatest challenge to teacher leadership is preparing the school and the teaching profession to begin thinking about the necessary paradigm shift regarding the authority in schools. This will lead to foundational changes in teacher

preparation programs and to the “very conception of the occupation of teaching” (p. 414).

In order to support teacher leadership, the literature identifies the need for changing the traditional school culture and climate from top down decision-making and teacher isolationism to one that supports collaborative leadership (Stone et al., 1997). In order for this to happen, school culture must be transformed. Katzenmeyer and Moller (1996) argued that current school culture does not foster teachers seeing themselves as leaders. Teachers hesitate to assume leadership roles because they hesitate being singled out from the group in an environment that has valued treating everyone the same. Ash and Persall (2000) concluded that sustained teacher leadership will only be successful if fundamental changes in the roles of teachers and administrators occur. A culture must be created in which the principal is not viewed as the controlling authority, but rather supports teachers and creates opportunities for them to develop and grow (Harris & Drake, 1997). While the culture of an organization can be changed to sustain broad leadership, Deal and Kennedy (1982) suggested that the culture itself could be a barrier to the changes that need to be made. Any attempt to change the culture will require that the principal study and understand the current culture of the building so that changes can be carefully inserted.

However, this new school culture must deal with resistance to change. Harris and Drake (1997) studied an effort to involve teachers in collaborative leadership without fundamentally changing the culture of the school. Participation in leadership was mandatory and was solicited in a traditional top down manner. The principal did

not explain the program fully until staff were already engaged in it. This created a lack of trust and thus further created resistance. The teachers' workloads and time commitments were already heavy, which made teachers resent the additional burdens of learning to work a new way. Harris and Drake identified these factors as limiting the realization of the project's full potential. At the end of the three-year study, Harris and Drake developed recommendations for creating a school culture to sustain participatory leadership. These included administration defining goals clearly from the beginning and allowing time for the staff to make sense of ongoing problems. Allowing time for change is crucial to increasing teachers' understanding of mandates from above and, consequently, to decreasing resistance.

*Climate and culture that support teacher leadership*. Empirical and theoretical literature about factors that support and sustain teacher leadership can be classified into two broad categories: the role and activities of the principal, and the level of collaboration on the campus. These two categories cover much of what happens on a given campus in terms of leadership both at the administrative level and at the teacher level. The empirical literature supports the importance of many of the factors that are integral to teacher leadership.

The role of the principal cannot be overstated (Buckner & McDowelle, 2000). In many cases, the tone and very nature of the building is set by this person. When asked, teacher leaders reported some specific actions principals could take to sustain teachers in leadership roles that include encouraging teachers to take initiative (Katzenmeyer & Moller, 2001), creating identified leadership roles for teachers, providing professional

learning and leadership development, developing creative time solutions, and creating time for "connecting opportunities" (Paulu & Winters, 1998, p. 18). These indicate deliberate and focused efforts by the principal to seek out new ways to do things on campus so that teachers are encouraged to enter into and to remain in leadership roles.

The strategy of the principal looking for or creating leadership roles for teachers is echoed by Childs-Bowen, Moller, and Scrivner (2000), Ash and Persall (2000), and Ryan (1999) with the latter adding the suggestion that the leadership role fall outside of the classroom responsibilities of the teachers. Hart (1994) and Little (1988) found that it is important for the principal to identify the leadership role as being related to the teaching and learning process rather than being administrative. There must be clarity in understanding of leadership roles on the part of the principal, the teacher leader, and fellow teachers (Smylie & Brownlee-Conyers, 1992). This formal identification of the leadership role helps the teacher leader to be accepted by colleagues.

Childs-Bowen, Moller, and Scrivner also suggested that the principal should engage teachers in action research to collect and analyze data and teaching strategies in their classrooms. Research - in and out of the classroom - allows teachers to take an intense look at a strategy or an idea. This relates to a larger school-wide focus on learning, inquiry, and reflective practice which also supports teacher leadership (Katzenmeyer & Moller, 2001). When teachers gain a deeper understanding of old and new strategies, they tend to use them more (R. Allen, 2002).

Ryan (1999) also suggested that principals must create a culture that has a strong commitment to mission, goals, and values and where teacher decision-making input is

valued. If positions for teacher leadership are created, even if they are driven by vision and goals, and then the teacher input is ignored or downplayed, that culture will soon destroy the desire of teachers to participate in leadership. This type of culture requires that a principal be comfortable not only with giving up some power inherent in the position, but also that the principal be comfortable in going with a suggestion or solution from a teacher leader. The principal, while encouraging risk taking among the teachers, will also have to be a risk taker when innovative ideas are presented. The principal needs to encourage and then support innovative practices on campus (Ash & Persall, 2000).

Collaboration on campus is also an essential part of sustaining an atmosphere conducive to teacher leadership. The literature showed that this collaborative effort must include teachers and administrators working together. There must be an expectation of teamwork and shared responsibility, including decision making (Katzenmeyer & Moller, 2001; Pellicer & Anderson, 1995). Little (2000) posited that a culture that can sustain teacher leadership is one in which teachers are in one another's classrooms for purposes of seeing, learning from, commenting on, and planning for one another's work with students. This implies a high level of trust among teachers which Silva et al. (2000) found to be an important factor in teacher leadership. Odell (1997) supported this idea of teachers observing each other and labels it as a requirement for sustaining teacher leadership. While some teacher leadership roles will fall outside of the classroom, there are significant amounts of leadership that can be demonstrated by simply working with another teacher in the classroom. Teachers open to being observed create a relationship-

driven atmosphere. This type of atmosphere was described by Donaldson (2001) as one that allows them to be shaped and then in turn to be a shaper of others. This shaping lies at the core of Donaldson's leadership theories.

*Barriers to teacher leadership.* Beyond the normal resistance to change, the literature identified some specific barriers that can hinder teacher leadership. Bondy (1995) found that a primary barrier to teacher leadership is the lack of a clear definition. As noted above, the definition of teacher leadership is still emerging and varies by context. This lack of definition has led to teachers being unable to see themselves as leaders or to know what a teacher leader is supposed to do in a school. Without clear roles or duties that are defined and accepted by administrators, teacher leaders, and other teachers, teacher leaders are left to create the definition on their own through personal experience. Ambiguities and uncertainties about roles cause tensions in relationships and interfere with teacher leadership (Smylie & Brownlee-Conyers, 1992). In the individualistic culture of schools, teachers willing or able to do this appear to be rare (Hart, 1994). It is imperative then that teacher leadership programs as well as school building administrators recognize and act on the need to clarify the role of a teacher leader.

Lack of leadership training for both preservice and practicing teachers is another barrier to teacher leadership. LeBlanc and Shelton (1997) argued that teacher leaders quickly become immersed in conflict with administrators and peers and lack the skills to resolve the conflict. Leadership training that included conflict resolution could help teacher leaders work through conflict to avoid being stymied in the leadership role.

Another area of conflict is that of resentment by other teachers toward the teacher leader. The literature showed that the individualistic nature of schools can lead to this resentment. Mitchell (1997) identified the cultural norms of individualism in schools as a barrier to teacher leadership. In this culture, the teacher willing to step into the role of a teacher leader is breaking out of this norm and challenging the historical role of the teacher.

A classroom teacher seen stepping into a leadership role is sometimes viewed in a negative light by fellow teachers. As this teacher leader attempts to rally fellow educators to solve a common problem, or to address an innovation, the very fact that the individualistic culture is being set aside sends up red flags and can begin building walls of resentment that did not exist before. Smylie and Denny (1990) concluded that teachers themselves may be one of the biggest barriers to teacher leadership. They suggested that the restructuring needed for school reform may be rejected or compromised by the very ones the reforms were designed to serve. If teacher leadership is to flourish, the norm of individualism needs to be addressed.

Many other barriers exist in schools that hinder teacher leaders from working effectively. These barriers can even keep teacher leadership from developing on a campus. Wynne (2001) listed too little time, rigid school schedules, unrelated instructional tasks, lack of support from peers and administrators, and an overemphasis on standardized tests scores as barriers to teacher leadership. Silva et al. (2000) noted that school organizations tend to value structure over people, and scheduling time for teachers to work together was often difficult for teacher leaders. The exercise of teacher

leadership was limited by the inflexible school structure. These are supported in the literature by many other researchers, but it appears that time constraints are mentioned consistently. Wynne (2001), Ryan (1999), and LeBlanc and Shelton (1997) all argued that lack of time is a barrier to effective teacher leadership.

LeBlanc and Shelton (1997) showed that the time spent on leadership activities diminished the time teachers could spend on their students. Teachers in many cases are not able to fulfill the time commitments for their own classrooms let alone adding the additional time constraints of leadership. Additional meetings, looking into new innovations, seeking input from peers, visiting other schools, and keeping up with current trends in schools are all time consuming activities that teacher leaders are involved with.

The list of barriers could be much lengthier. The literature also showed that resistance due to a lack of reflection (Moller, 1999) both personal and collegial, teachers thinking that teacher leadership is simply the latest wave of reform and that it will die out (Mooney, 1994), and a lack of professional identity (Mitchell, 1997) were all significant barriers to teacher leadership. A powerful factor in the effort to break down barriers to sustaining teacher leadership in schools is for administrators and teacher leaders to address the issues of culture. Not only what needs to be changed in the current school culture that pervades education as a whole, but also to address the ideas of what the new culture will look like.

*Summary*

The development of teacher leadership depends on many factors. There are a wide variety of formats for implementing teacher leadership professional development; however, effective formats all share the same characteristics. First, effective development provides opportunities for active learning, it must reflect teachers' experiences, and it must be grounded in their actual teaching content. Effective leadership development is sustained over time and includes accountability for implementation. There are important community aspects of effective development, including teacher collaboration and the systemic support of teacher development initiatives. Teacher leadership is more than the development, however. It also involves adoption of change into the daily classroom. Teachers' self-efficacy is the strongest correlation to the adoption of leadership skills, though the causation remains unclear.

These theories about the development of teacher leadership can be applied to all types of programs, including school-university partnerships, the state educational agency and district-based plans, and special-purpose programs, though each has its particular characteristics. The effectiveness of any program will depend upon the school culture, however, and several studies have outlined the kinds of cultures that foster or inhibit change and outline specific steps to allow for maximal teacher development. Across numerous studies detailed above, the single most critical factor in the teachers' leadership roles and activities is the campus principal. The principal and assistant principals set the tone for teacher leadership and define roles for teacher leaders. They can create a culture that values teacher decision-making input or that ignores it. The

principal can support an atmosphere that encourages or discourages teacher collaboration.

# CHAPTER III

# METHODOLOGY

This chapter outlines the methodology employed in the present study. The purpose of this study was to explore the changes in teachers' descriptions of their leadership in their school settings before and after their participation in a science education leadership program and the aspects of their science education leadership experience that selected teachers identify as contributing to their change in leadership. A quantitative analysis of the two administrations of the Teacher Leadership Roles Survey and demographic data on ITS Center Cohort II teacher-participants were used to answer Question 1: How do teachers describe their leadership roles and activities in their school settings before and after their participation in a science education leadership program? A qualitative research design involving interviews, field observations, and document analysis was used to answer Question 2: Of the teachers who reported the greatest increase in their leadership roles and activities, what aspects of their science education leadership experience do they identify as contributing to their change in leadership? A brief administrator questionnaire was used as a means of triangulation of the data. This chapter includes a description of the participants, the data collection procedures, and the procedures used for data analysis.

## Research Design

Research in the present study is descriptive, looking at "what happened when…" (Shavelson & Towne, 2002). This study examines only ITS Center participants and makes no effort to compare them to any other group. Participants in Cohort II self-

selected to apply and to a large degree selected their science teams (described in Chapter I). Thus, the research design is a study of what happened to the Cohort II teachers. In the present study, a single pretest ($O_1$) is followed by a treatment (X) and then a posttest that is identical to the pretest ($O_2$):

$$O_1 \quad X \quad O_2$$

The above design is vulnerable to threats of internal validity for causal inference, especially maturation and history threats. However, since no causal attribution will be made in answering Question 1, these threats are not a concern. Using the same measure for pretest and posttest can cause fatigue effects, practice effects, and carryover effects. However, the time elapsed between the pretest (spring 2003) and posttest (fall 2006/winter 2007) minimized these effects. On the other hand, this nearly four-year time period would increase the confounding of history and maturation threats for making any causal inferences.

A case study will be used as the qualitative design to answer Question 2: Of the teachers who reported the greatest increase in their leadership roles and activities, what aspects of their science education leadership experience do they identify as contributing to their change in leadership? Yin (2003) identifies four basic types of case study design shown in Figure 3.1.

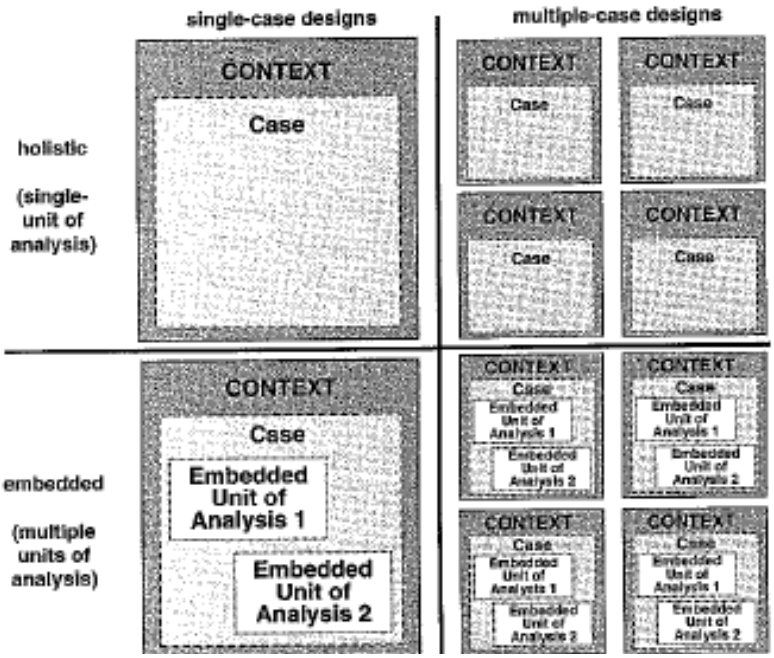


**Figure 3. 1** *Basic types of designs for case studies (Yin, 2003, p. 42)*

The present study uses an embedded single-case design to answer Question 2. The Context is externally-funded, university-based, information technology teacher leadership professional development program. The Case is the ITS Center (described in Chapter 1). The Embedded Units of Analysis are the teachers identified through the pretest and posttest from Question 1 as having the greatest increase in teacher leadership roles and activities. This design was selected since the focus of both the questions and the conclusions drawn is the ITS Center.

## Participants

Two groups of participants were used in the present study. The population for Question 1 was members of ITS Center Cohort II who were classroom teachers

throughout their two years of ITS Center activities (teacher-participants). A selected subset of this population was identified for the detailed case study to answer Question 2.

Question 1: There were 36 teachers on the original Cohort II participant list. Of these, one never attended and another was a demonstration teacher and did not have her own classroom. Thus, 34 classroom teachers attended Summer 1. Of these 34 teachers, three left the classroom to become full time graduate students, and five did not attend summer two. Of the 26 classroom teachers that completed both summers, two had to be excluded for not completing the original Teacher Leadership Roles Survey that was a part of the ITS Center application. After completing Summer 2, one classroom teacher retired and another finished his doctorate and took a faculty position in Curriculum and Instruction at a university. This left 22 classroom teachers from Cohort II who were still teaching in the classroom in the fall of 2006. These 22 teachers were contacted by ITS Center staff and requested to complete the post-project evaluation during the fall of 2006. Of these 22 teachers, 15 responded and completed the follow-up evaluation surveys by April 11, 2007 for a response rate of 68%. Of these 15 teachers, seven were White females, four were White males, and four were Hispanic females. Comparison of the demographics of the teachers responding to the ITS Center follow-up survey to Texas statewide percentages in the school year 2002-2003 (the year these teachers applied to the ITS Center) is shown in Table 3.1 (Fuller & Alexander, 2002). ITS Center teacher-participants included a greater percentage of White males and Hispanic females than the Texas teacher population in general.

**Table 3.1**
**Texas Teacher Demographics 2002-2003 Compared to ITS Participants**

| | Statewide | ITS Teacher Participants |
|---|---|---|
| White | 72.5% | 73.4% |
| White male | 15.9% | 26.7% |
| White female | 56.6% | 46.7% |
| Hispanic | 17.4% | 26.7% |
| Hispanic male | 4.6% | 0.0% |
| Hispanic female | 12.8% | 26.7% |
| Other | 10.1% | 0.0% |

Survey information provided by all 15 respondents was used to answer Question 1. Responses on survey information also were used to identify a purposive sample to participate in case studies to answer Question 2. Since Question 2 asks of the teachers who reported the greatest increase in their leadership roles and activities, what aspects of their science education leadership experience do they identify as contributing to their change in leadership, teachers who were in the classroom during their entire ITS Center participation and who demonstrated operationalization of considerable leadership growth were identified. "Growth" was defined primarily as a self-reported increase in leadership roles and activities on the *Teacher Leadership Roles Survey* described below. Since leadership opportunities may be limited in small schools with few teachers, selection was limited to teachers in urban and suburban schools large enough to have more than one science teacher at each grade level. Gender, ethnicity, and geographic location were also considered in the purposive sample. An individual identification number, the PKID, was assigned to every ITS Center participant. Based on responses to the *Teacher Leadership Roles Survey*, two teachers, PKID 39 and PKID 106 stood out as exhibiting a

great deal of change as shown in Table 3.2. Since these two teachers, one White male and one Hispanic female, one a middle school science teacher and one a high school math teacher, were diverse in gender, ethnicity, experience, and setting, the purposive

**Table 3.2**
**Change in Leadership Survey Scores**

| PKID | Role Change | Activity Change | Total Change |
|---|---|---|---|
| 39 | 9 | 11 | 20 |
| 106 | 13 | 6 | 19 |
| 44 | 3 | 5 | 8 |
| 91 | 5 | 2 | 7 |
| 74 | 4 | 2 | 6 |
| 84 | 2 | 3 | 5 |
| 192 | -4 | 5 | 1 |
| 166 | 1 | -1 | 0 |
| 112 | 4 | -4 | 0 |
| 9 | -4 | 2 | -2 |
| 53 | -4 | -2 | -6 |
| 36 | -4 | -2 | -6 |
| 110 | -4 | -6 | -10 |
| 179 | -7 | -7 | -14 |
| 155 | -6 | -21 | -27 |

sample was determined to be these two teachers. The two teachers were from different regions of the state. One teacher was from a large urban school district, and the other was from a rapidly growing metropolitan suburb. They were contacted to participate in the three-part interview for Question 2 based on changes in survey results from the application in the spring of 2003 and the follow-up survey in fall 2006/winter 2007.

## Instruments

*Quantitative Instruments*

Quantitative instruments used in the present study were those developed by ITS Center faculty. The *ITS Center Application* was required for all participants and was completed in the spring 2003 for Cohort II. It provided basic demographic information, training and experience, information about their schools, professional development opportunities, and role of technology. The application had an open-ended format that asks questions about teaching experiences, practices, curriculum, and goals. It also included the *Teacher Leadership Roles Survey* (Appendix A), a combination of two instruments developed by Smylie and Denny (1990): (a) Teacher Leaders' Definitions of Leadership Roles and (b) Activities of Teacher Leaders by Time Expended. Smylie and Denny used a multistage interactive method of data collection, analysis, and interpretation to develop these surveys. They first conducted open-ended interviews with teacher leaders asking them how they defined their roles as leaders, what leadership activities they engaged in, and what factors influenced their leadership. These data were analyzed using a comparative method (Glasser & Strauss, 1967) to identify themes and patterns. The themes and patterns were then discussed with district-level school personnel not directly involved with the teacher leadership program. After this discussion, themes and patterns were codified and developed into Likert-type surveys that were administered to each of the teacher leaders. In their study, Smylie and Denny identified eight teacher leadership roles and eight teacher leadership activities. Neither reliability nor validity was reported for these surveys; however, they were computed for

this study. The eight leadership roles are: facilitator/enabler, helper for teachers, catalyst for individual improvement, generator of new ideas, source of emotional support for teachers, source of knowledge for teachers, administrator of programs and policies, and evaluator of other teachers. The eight leadership activities are: attend (participate in) program-related meetings; engage in building-level decision making related to curricular, instructional and professional development planning; develop district-level curricular programs; develop curricular/instructional materials; plan building-level staff development activities; develop building-level curricular/instructional programs; meet with principal to discuss principal's concerns and plans for the campus; and promote implementation of district-level programs.

These 16 descriptors were combined into a single instrument with a five-point Likert-like scale. The descriptors are consistent with the teacher leadership roles demonstrated within the school setting identified by York-Barr (2004) and the National Teachers Forum (Paulu & Winters, 1998) summarized in Tables 2.1 and 2.2. Teacher-participants were asked as a part of their original ITS Center application to indicate the extent to which they engage in these activities from 1 (*Not at all* and 5 (*To a very great extent*). This survey was re-administered online to Cohort II participants in the fall of 2006 through the winter of 2007.

*Reliability*. Although Smylie and Denny (1990) did not report reliability for the scores on the leadership surveys for their data, both reliability and confidence intervals were computed for the present study. Recommendations from the American Psychological Association Task Force (Wilkinson & APA Task Force on Statistical

Inference, 1999) propose that psychometric properties, including reliability coefficients, be reported whenever tests or other measurement instruments are used. It is important to note that reliability is *not* a property belonging to a particular measurement instrument; it *is* a property belonging to a *particular set of scores*. Reliability should be calculated for each administration of an instrument. A popular graduate education research textbook defines reliability as "the consistency, stability, and precision of test *scores*" (Gall, Borg, & Gall, 1996, p. 197, emphasis added).

A common method of estimating a test's internal consistency (reliability) is the method of rational equivalence, the most common of which are the Kuder-Richardson formulas, K-R 20 and K-R 21. However, these formulas only apply to dichotomously scored instruments. Since the survey used in the present study was a five-point Likert-type scale, the more generalized form of the K-R 20 formula, Cronbach's coefficient alpha ($\alpha$), was used (Cronbach, 1951). Cronbach's alpha ranges from 0.00 (no reliability) to 1.00 (perfect reliability, which does not happen since all measurements have some degree of error). Cronbach's alpha was calculated for each administration of the Smylie and Denny (1990) survey. Confidence intervals (CI) are reported since reliability coefficients, like other statistical estimates, are influenced by sampling error variance (Fan & Thompson, 2001) and using CIs when reporting reliability is urged by the guidelines of *Educational and Psychological Measurement.*

A reliability analysis of the scores of all applicants to Cohort II yielded a Cronbach's alpha of 0.95 (99 percent CI: 0.83-0.97) on the 16 items of the Teacher Leadership Roles Survey included on the Spring 2003 application. Of the participants in

Cohort II identifying themselves as classroom teachers, a reliability analysis of their scores yielded $\alpha = 0.90$ (99 percent CI: 0.82-0.95). Application survey for participants in the present study yielded $\alpha = 0.90$ (99 percent CI: 0.77-0.97) for their 2003 scores and $\alpha = 0.94$ (99 percent CI: 0.85-0.91) for the 2006 follow-up. Since scores with a Cronbach's alpha of more than .80 are considered reliable, it can be concluded that these scores are reliable.

*Qualitative Instruments*

*Interview protocol*. A modified *Microcosmos Interview Protocol* (Martinez, 2000) was adapted and used in personal onsite meetings with the purposive sample of respondents. This protocol was developed in collaboration with the leadership of the NSF-funded Microcosmos project, a professional development and teacher leadership Teacher Enhancement project (DLR 9153826; $1,129,126; 1992-1996) that had similar goals and objectives to those of the ITS Center. Microcosmos brought teachers in for a two-week science content experience during the summer. The following summer, a subset of those teachers was brought in for a one-week leadership development experience. During the academic year between the two summers and following the second summer, teachers were accountable for implementing Microcosmos science and leadership. The ITS Center brought teachers in for three weeks in each of two successive summers for integrated science content and leadership development. Teachers were accountable for implementation of both content and leadership.

The Martinez study followed up with 15 of the teachers who participated in both the science and the leadership experiences. The interview protocol was piloted on four

selected Microcosmos participants, refined as a result of this pilot, and requires an hour and a half to administer. The Microcosmos protocol asked how teacher-participants defined leadership, what leadership roles they assumed, and to which components of their NSF experience teachers attribute changes, if any, in their leadership. This protocol was selected to allow for comparison of results between the two NSF-funded leadership projects. It was adapted to change the wording specific to the Microcosmos project to terminology used by the ITS Center that teacher-participants would be familiar with and to break it up into three sections that could be administered independently to minimize impact on respondents. The three sections can be categorized as (a) definitions and views of leadership, (b) leadership activities, and (c) attribution for leadership development (Appendix B).

*Observations.* Observations occurred at each site over a two-day period in May 2007 at the same time the interviews were conducted. A total of 15 hours was spent on each campus. The interviews were conducted in three sessions, each totaling an hour and a half. The rest of the time was spent observing the teacher-participants' classrooms and interactions with teachers and students, touring the campuses, visiting with students, teachers, librarians, counselors, administrators, coaches, and support staff. Student arrival and departure, class transitions, and lunch periods were observed. Outside of school time, the attendance zone for each school was explored. The researcher drove through neighborhoods, visited stores, gas stations, coffee shops, and restaurants in the area visiting with servers, employees, and customers about the area and their interactions with the schools. Extensive field notes were collected.

*Researcher*. In case study research, as in all qualitative research, the researcher is an important, some say the most important, research instrument (Erlandson, Harris, Skipper, & Allen, 1993). According to Yin (2003), skills needed in a case study investigator include question asking, listening, adaptiveness and flexibility, and grasp of the issue being studied. Yin also includes lack of bias as a skill, which appears odd, if not impossible in qualitative research since most qualitative researchers agree that "human beings must operate within realities that they themselves have constructed" (Erlandson et al., 1993, p. 21). However, further examination of Yin's description of lack of bias indicates that he is referring to not conducting a case study to substantiate a preconceived notion. In addition to *skills*, a word which implies something that can be developed with prescriptive practice such as running drills in athletics or playing scales in music, researchers using case studies may also need certain *characteristics*, *dispositions* or *habits of the mind*.

Qualitative research is by nature subjective. The researcher interprets the data and reports findings or assertions (Stake, 1995). The reader, in turn interprets these assertions. In order to maintain the greatest possible credibility, it is important for the researcher to make her "perch and perspective" known to the reader (Lawrence-Lightfoot & Davis, 1997). The researcher in the present study has 17 years of classroom teaching experience between 1976 and 2000 in Texas public schools in both mathematics and special education. This experience ranges from first to ninth grade in high-minority, low-income schools in a major urban school district, a small rural school district, and a mid-sized city school district not associated with a larger, urban region.

During this time, the researcher experienced a wide variety of school leadership philosophies and styles working for five superintendents and nine principals on one EC-2 campus, two middle school campuses, and one junior high campus. Leadership ranged from an autocratic, top-down approach that fostered isolation to the career ladder years that fostered competition to a participatory leadership style that fostered collegiality (Donaldson, 2001). All three waves of teacher leadership discussed in Chapter II were experienced by the researcher including first wave (department head for four years), second wave (career ladder two and three), and third wave (informal leadership based on distributed expertise). The researcher was also a graduate student in Cohort 1 of the ITS Center. This variety of experience prepared the researcher to understand the professional development experience in the ITS Center and teacher-to-teacher interactions in the schools. In fact, the greatest threat to researcher credibility is "going native" and identifying too closely with respondents selected for the purposive sample (Stake, 1995). The researcher addressed this by choosing Cohort II instead of her own cohort and limiting time interacting with the teacher-participants. Awareness of this threat and a conscious effort to watch for identifying with the teacher participants reduced this threat.

*Existing documents*. Each ITS participant developed an individual Instructional Framework during Summer 1 (2003) and a Practitioner Research Plan during Summer 2 (2004). These Instructional Frameworks, developed during the afternoon education course, were based on science content gained from the project teams and included (a) identification of a learning challenge, (b) scientific inquiry problem/question, (c)

information technology applications, (d) assessments, (e), description of learning experiences with instructional technologies, and (f) strategic plan for implementation. The Practitioner Research Plans were based on the Instructional Frameworks and included (a) rationale for the intervention including research base and current theory, (b) inquiry questions, (c) research methodology, and (d) instruments. These documents were used as triangulation to provide information related to the teacher-participants' descriptions of their ITS Center experience.

Facet Innovations, the external evaluator for the ITS Center, conducted a follow-up survey at the same time the post-experience *Teacher Leadership Roles Survey* was conducted. The external evaluator's instrument was primarily an open-ended survey that asked questions about current position, the role of the ITS Center experience in their current positions, their current use of technology, and their efforts at acquiring external funding. This survey was used to determine which ITS Center participants were currently classroom teachers and to locate these teachers. It was also used to determine which teachers had assumed new leadership positions and which teachers had changed schools or districts.

*Administrator survey*. For triangulation, an Administrator Survey (Appendix C) information was collected for each teacher respondent. Each teacher was asked to identify one administrator who was familiar with the teacher's leadership and participation in ITS Center activities. The information sheet and survey were then emailed to the administrator. Two administrators were asked to complete this survey, one for each teacher in the purposive sample. There was a 100% response rate.

## Data Collection

Data collection occurred over four years beginning with the Cohort II applications completed in the spring of 2003. The timeline of data collection is shown in Table 3.3.

**Table 3.3**
**Timeline of Data Collection**

| Instrument | Spring 2003 | Summer 2003 | Summer 2004 | 2006-2007 |
|---|---|---|---|---|
| ITS Center Application | ♦ | | | |
| Teacher Leadership Roles Survey | ♦ | | | ♦ |
| Instructional Framework | | ♦ | | |
| Practitioner Research Plan | | | ♦ | |
| Leadership Interview with Purposive Sample | | | | ♦ |
| Observation | | | | ♦ |
| Administrator Survey | | | | ♦ |

Question 1: How do teachers describe their leadership roles and activities in their school settings before and after their participation in a science education leadership program?

Existing data collected by ITS Center faculty, staff, and graduate students were used to answer Question 1. Initial data collection began in the spring of 2003 with the submission of applications to Cohort II. Applicants had the option to apply online or to print and mail in the application. As work began on the present study, it was discovered that there was an error in the online survey in the original application; question 8 of the activities portion of the survey "Promote implementation of district-level programs" was inadvertently left off, although it printed when applicants chose to download and print

the application rather than to fill it out online. A seventeenth question was added that was not in the original Smylie and Denny (1990) survey, "Participate in formal classroom inquiry." This question appeared on all versions of the survey, both 2003 and 2006. Thus, the Smylie and Denny item "Promote implementation of district-level programs" was deleted from analysis and replaced by "Participate in formal classroom inquiry," leaving 16 items on the survey.

Question 2: Of the teachers who reported the greatest increase in their leadership roles and activities, what aspects of their science education leadership experience do they identify as contributing to their change in leadership?

Two teachers were selected as units of analysis for the case study based on the self-reported change in their leadership from the Teacher Leadership Roles Survey completed for the application in 2003 and the follow-up administration of the survey nearly four years later. Selection of these teachers is described above and in Chapter IV. The two teachers were contacted by telephone in April 2007 about participation in the study. Each of them agreed to participate, and arrangements for an interview and observation were made by email. Prior to each observation, the teachers and their administrators each signed a consent form to participate in this research effort. Additionally before each observation, background information about each teacher's school was collected from the Academic Excellence Indicator System Reports (AEIS) published on the Texas Education Agency website (2006) and the school district and campus websites.

Observations and interviews were conducted in May 2007 over a three-day period at each site. May was chosen since it is after Texas Assessment of Knowledge and Skills (TAKS) testing and before finals. Each teacher was visited onsite over three days. Visits included a structured interview with the teachers over three separate sessions, classroom observations, unstructured dialog with the teachers, and campus-wide and community observations. At one site, the administrator survey information was collected through an interview. At the other site, the survey was conducted by email. The methodology for completing the administrator survey was chosen by the administrator at each site. While a face-to-face interview allows for clarification and follow-up questions, the difference in quality of response in the present study was probably minimal. The administrator who chose the face-to-face interview had known the ITS Center teacher-participant for more than ten years, was in the same content area, and had taught with and presented professional development workshops with the ITS Center teacher-participant before becoming an administrator. In the other case, none of the building level administrators were in the ITS Center teacher-participant's content area. The building principal had known the ITS Center teacher-participant for two years, the other administrator for less than that. The administrator who was chosen by the teacher-participant and the building administrators to complete the survey had known the teacher-participant for less than a full year and only in their current roles. Interviews were transcribed and emailed to the participants for a member check within a week of each visit.

## Quantitative Data Analysis

Quantitative data were analyzed using SPSS 16.0 software. Question 1: How do ITS Center teacher-participants demonstrate leadership in their school settings (both in science and technology)? was answered through quantitative analysis of pre- and post-Leadership Practices Inventory items. It is common in research publications to treat Likert-type data as interval, as Smylie and Denny did in developing this inventory. Therefore, descriptive parameters including mean and standard deviation will be calculated and reported. However, since statistical purists treat Likert-type data as ordinal data (Hinkle, Wiersma, & Jurs, 1998), a five-number summary (minimum, $Q_1$, median, $Q_3$, maximum) will also be reported (Moore & McCabe, 2003). The Leadership Practices Inventory was a part of the ITS Center application completed for admission to the program by all participants. It was also administered as a follow-up one year after completion of ITS Center activities.

Data used to answer Question 1 were provided by all 15 of the 22 classroom teachers in Cohort II responding to the follow-up survey.

## Qualitative Data Analysis

Qualitative data were used to develop the case study. Interviews were transcribed verbatim using Microsoft Word 2003. Files were then imported into Atlas.ti for coding. Electronic versions of the selected teachers' Instructional Frameworks and Practitioner Research Plans were obtained and imported. Field notes were transcribed and imported also. Because of differences in school settings, responses to the administrator survey were collected differently. The survey administered by interview

was transcribed and imported. The survey administered by email was in electronic form and imported directly.

Data analysis followed the steps described by Lincoln and Guba (1985):

1. All information collected, including interviews, field notes, and administrator surveys were divided into individual units of data consisting of complete thoughts or single ideas.
2. These individual units of data were analyzed, given a code in Atlas.ti, and grouped by theme. Codes and themes were compared to codes and themes developed in the Martinez *Microcosmos* (2000) study.
3. Data were examined to test rival explanations. Yin (2003) describes nine types of rival explanations: (1) the null hypothesis, (2) threats to validity, (3) investigator bias, (4) direct rival, (5) commingled rival, (6) implementation rival, (7) rival theory, (8), super rival, and (9) societal rival. As Yin states, the more rival explanations that are examined and rejected, the greater the confidence is in the findings reported in Chapter IV.
4. Categories and themes were refined, combined, bridged, and extended. When categories overlapped, they were combined; when they were related or connected they were "bridged". Viable but incomplete categories were extended through additional data collection or by extending the boundaries of the theme.

Since the interview protocol in this study was modified from the Martinez (2000) study, codes and categories developed by Martinez were used as a starting point for

analysis. Twenty of Martinez's codes applied directly to data in this study. Six additional codes that did not appear in the original study emerged to categorize units from the ITS teacher interviews. Details of ITS Codes and definitions of each code are shown in Table 3.4.

**Table 3.4**
**Codes and Definitions Used in the Present Study**

| Code | Definition of the code |
|---|---|
| Accept ITS phil | Comments by the participant indicating an acceptance of the ITS Center philosophy |
| Comfort with content | Comments by the participant indicating a comfort with the science content from their team |
| Impor of share | Comments by the participant concerning the importance of sharing with colleagues |
| Comm resources | Comments by the participant mentioning the use of community resources |
| Effective comm. | Effective communication |
| Desire to learn | Comments by the participant indicating a desire to learn |
| Political savvy | Comments by the participant indicating an understanding of school structure impacting leadership |
| Self initiative | Comments by the participant indicating self initiative |
| Social personality | Comments by the participant indicating a social personality |
| Background | Participant's response to the requests, "Please tell me briefly why you entered teaching," and "Please give me a general timeline of your teaching career." |
| Change in curr | Participant's response to the question, "In what areas of your science curriculum do you now include technology? Has this been influenced by the ITS Center program?" |
| Change in pedagogy | Participant's response to the question, "Have your science teaching strategies changed as a result of the ITS Center program?" |

Table 3.4 Continued

| Code | Definition of the code |
|---|---|
| Change nature sci | Participant's response to the question, "Have your science teaching strategies changed as a result of the ITS Center program? In what ways has your perspective on science changed?" |
| TL definition | Participant's response to the question, "What does teacher leadership mean to you?" |
| TL behavior | Participant's response to the question, "What do you believe are important behaviors for a teacher leader to have?" |
| TL are you | Participant's response to the question, "Do you consider yourself to be a teacher leader?" |
| TL activities prior | Participant's response to the question, "Prior to participating in the ITS Center program, in what types of teacher leadership have you participated?" |
| TL post | Teacher leadership activities after ITS but not current |
| TL activities current | Participant's response to the question, "Since participating in the ITS Center program, in what types of teacher leadership have you participated?" |
| TL greater status | Participant's response to the question, "Did the ITS Center enhance your image as a teacher leader within your school or district?" |
| Ongoing PD | Professional development after ITS |
| TL Workshop PD | Presentation of workshops or other PD after ITS |
| Impact of ITS | Changes since participation that participant attributes to ITS |
| Barriers | Barriers to implementing ITS curriculum |
| Non-ITS tech support | Current technology leadership activities not related to ITS Center participation |
| Impact ITS Structure | Aspects of ITS structure that were important to leadership development |

*Building Trustworthiness*

Qualitative research has a long and varied history. It has had many and widely varied definitions over the years, but Denzin and Lincoln (2000, p. 3) offer this generic definition:

> Qualitative research is a situated activity that locates the observer in the world….This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them.

The case study methodology in the present study is just one of many qualitative methodologies. In the preface to his book on case study design and methodology, Yin (2003, p. xiii) calls case study "a weak sibling" among qualitative methodologies and warns that case study researchers have been regarded as having "downgraded their academic disciplines." It is important, therefore, that case study researchers build "trustworthiness" into their research (Lincoln & Guba, 1985). Erlandson et al. (1993) define trustworthiness as demonstrating truth value, providing a basis for application, and allowing a means for external judgments of research quality to be made. In quantitative research, this is done through paying attention to validity, generalizability, reliability, and objectivity. Qualitative research seeks to be credible, transferable, dependable, and confirmable. The relationship between these elements is shown in Table 3.5. Each element is discussed below in terms of the present study.

**Table 3.5**
**Elements of Quantitative and Qualitative Research**

| | Quantitative | Qualitative |
|---|---|---|
| Truth value | Validity | Credibility |
| Applicability | Generalizability | Transferability |
| Consistency | Reliability | Dependability |
| Neutrality | Objectivity | Confirmability |

*Credibility*

Truth value is judged on credibility rather than validity. The five characteristics of credibility are prolonged engagement, triangulation, referential adequacy, peer debriefing, member checks, and maintaining a reflexive journal (Erlandson et al., 1993).

Prolonged engagement between the researcher and participants in this study was marginal because of distances involved. Phone and email contact were maintained for a total of six months before and after the three-day observations and interviews at each site. However, this limited direct engagement was somewhat overcome by the prolonged engagement of the participants and the researcher with the ITS Center. The ITS Center engagement covers a 2.5 year period. Cohort II applied to the ITS Center in Spring 2003, came to Texas A&M for Center activities for three weeks in July of 2003, implemented their Instructional Framework and reported on results during the academic year 2003-2004, returned to Texas A&M for three weeks in July of 2004, and implemented their Practitioner Research Plan in the academic year 2004-2005. The researcher had a similar prolonged experience with Cohort I. This shared experience and the researcher's background as a public school teacher in districts similar to the

participants' districts allowed the researcher to understand the teacher-participants' environments and gave the researcher credibility with them.

Triangulation is the use of multiple sources of evidence. Triangulation in this study occurred through the collection of data from multiple sources. The primary data source was from the structured interviews along with classroom observations and informal campus-wide perceptions through a tour of the campus environment and interactions between teachers, students, and others on the campus and discussions with individuals about their various experiences. Field notes were collected during the campus visits. Additional sources of data include the administrator survey (Appendix C) given to one campus administrator for each participant, the Instructional Frameworks and Practitioner Research Plans, and the participants' answers to the open-ended questions on evaluation surveys administered by Facet Innovations, the external evaluators for the ITS Center.

Referential adequacy materials included Academic Excellence Indicator System (AEIS) data collected by the Texas Education Agency (TEA) and available on the TEA website by campus and district for every year since the 1993-1994 school year (Texas Education Agency, 2007). Information about each school district and campus was also collected from the respective school websites. Google Maps™ and Google Earth™ were consulted to gain an understanding of the relationships between the campuses and their broader communities. Census data from the Texas State Demographer (Texas State Data Center and Office of the State Demographer, 2005) were collected to increase understanding of the school community.

Peer debriefing was used to provide feedback to guide inquiry. A recent doctoral graduate (2006) from the Texas A&M College of Education and Human Development was used as the peer debriefer. She was involved in the development and start up of the ITS Center and has been aware of this research study since the proposal was developed. Her understanding of state and national issues in K-12 science and mathematics education provided valuable insights to the effort. She also has extensive experience in research development. It has been several years since she was involved in the ITS Center, so she was removed enough to debrief, provide feedback and provide alternative methods when needed.

Since qualitative research involves the interpretation of multiple realities, it is important that data and interpretation be verified by individuals involved in the study (Erlandson et al., 1993). During the interviews, the researcher restated and requested clarification of participant information. Transcribed interviews were provided to participants along with additional questions for clarification. As data analysis proceeded, follow-up clarification and amplification was requested.

A reflective journal was kept at all stages of preparation, data collection, data analysis, and write up. This artifact was especially important because of the long timeline from inception to completion of this research project.

*Transferability*

Applicability of qualitative research is called transferability rather than the positivist generalizability. In addition to the reflexive journal, transferability is characterized by thick description and purposive sampling (Erlandson et al., 1993).

Purposive sampling was outlined at the beginning of the study. It was decided that two to four teachers indicating exceptional teacher leadership would be the best respondents for answering Question 2. When the analysis of the pre and post Teacher Leadership Survey was completed, two teachers stood out above the other respondents. The open-ended responses on the Facet Innovations survey were examined to confirm the Teacher Leadership Survey results. The two identified teachers were contacted, and they agreed to participate in the research. Details of their responses to the Teacher Leadership Survey and the Facet Innovations survey are provided in Chapter IV.

Also in Chapter IV are descriptions of the settings, the participants, and their responses as part of the thick description. Also included are descriptions of reactions of participants, a discussion of important issues, a discussion of themes that emerged, and as accurately as possible, the participants' constructed realities. This rich description should "enable observers of other contexts to make tentative judgments about applicability of certain observations for the contexts and to form 'working hypotheses' to guide empirical inquiry in those contexts" (Erlandson et al., 1993, p. 33).

*Dependability*

Consistency is addressed in qualitative research through dependability rather than reliability. Dependability is met through a dependability audit that asks how decisions about methods, units, codes, and themes are made. In order to build dependability, an audit trail has been established. Interview protocols, descriptions of participants and settings, e-mails, and transcribed interviews have all been maintained so that anyone can follow this study from beginning to conclusion.

*Confirmability*

Positivist quantitative research seeks neutrality through objectivity. Qualitative research does not claim to be objective but does seek neutrality through confirmability. Confirmability was met through triangulation, a reflexive journal, and an audit trail, as discussed above.

## Summary

This chapter outlined the methodology that was used in the present study. The purpose of this study was to investigate what ITS Center teacher-participants do in their school settings to demonstrate leadership (both in science and IT) and to what extent teachers attribute changes in their leadership to their NSF experience. Included in this chapter were a description of the research design, the participants, and the instruments. Analysis of both quantitative and qualitative data was described. The first question was investigated through quantitative data, and the second question involved qualitative research methodology.

# CHAPTER IV

# RESULTS

This chapter presents the results of this study. The purpose of this study was to identify the connection, if any, between teacher-participants' leadership characteristics, roles, and activities and the factors of ITS Center participation that impacted the teacher-participants' leadership roles. Members of Cohort II applied to participate in the ITS Center in the Spring of 2003. They participated in ITS Center coursework in Summer 1 (2003). During the academic year 2003-2004, they implemented their Instructional Frameworks developed during the summer courses. They returned to the Texas A&M campus for additional coursework during Summer 2 (2004) and implemented the Practitioner Research Plans during academic year 2004-2005. Follow-up surveys of all participants in both Cohorts I and II were begun in Fall 2008. All 26 classroom teachers completing Cohort II were located; of these, 22 were still in the classroom. These 22 teachers were contacted by ITS Center staff and requested to complete the post-project evaluation during the fall of 2006. Of these 22 teachers, 15 responded and completed the follow-up evaluation surveys by April 11, 2007 for a response rate of 68%. Of these 15 teachers who responded, seven were White females, four were White males, and four were Hispanic females. Their responses are reported in this chapter.

## Research Question 1

Question 1 asked: How do teachers describe their leadership roles and activities in their school settings before and after their participation in a science education leadership program? In this section, pre- and post-project results of the Teacher

Leadership Roles Survey are discussed. The Leadership Roles Survey is divided into two parts: Roles and Activities. *Roles* were how teachers perceived themselves as leaders. *Activities* described what teachers did as leaders.

*Roles*

Teachers were asked to rate the extent to which eight leadership functions matched their current role at school from 1 (*Not at all*) to 5 (*To a very great extent*). These leadership functions (roles) were: (1) Facilitator/enabler, (2) Helper for teachers, (3) Catalyst for individual improvement, (4) Generator of new ideas for teachers, (5) Source of emotional support for teachers, (6) Source of knowledge for teachers, (7) Administrator of programs and policies, and (8) Evaluator of other teachers. None of these roles were defined in the survey, so interpretation of each role was open to each respondent's understanding. Rating scales such as the one in this survey are considered ordinal data by statistical purists since there is no guarantee that the "distance" between one point and another point is uniform to all respondents (Jamieson, 2004). However, as a practical matter, many in education literature treat this type of data as interval and report mean and standard deviation, as Smylie and Denny (1990) did in their article. Thus, Table 4.1 shows the mean and standard deviation for each item for the pre-ITS experience (Spring 2003) and post-ITS experience (Fall 2006) administration of the survey.

Comparing responses on roles across the Spring 2003 and Fall 2006 surveys is complex. Between Spring 2003 and Fall 2006, the mean for four of the roles increased and the mean for four of the roles decreased. As shown in Table 4.1, the two roles most

closely associated with traditional administrator/principal duties, (7) *Administrator of programs and policies* and (8) *Evaluator of other teachers* were rated as being the least match to their current roles for all three groups.

**Table 4. 1**
**Study Participants Pre-ITS Center Experience (Spring 2003) and Post-ITS Center Experience (Fall 2006)**

| | Spring 2003 | | Fall 2006 | |
|---|---|---|---|---|
| Leadership Roles | Mean | SD | Mean | SD |
| 1. Facilitator/enabler | 4.22 | 0.97 | 4.11 | 1.17 |
| 2. Helper for teachers | 4.56 | 0.53 | 4.33 | 1.12 |
| 3. Catalyst for individual teacher improvement | 4.00 | 0.87 | 4.44 | 0.88 |
| 4. Generator of new ideas for teachers | 4.22 | 0.83 | 4.67 | 0.50 |
| 5. Source of emotional support for teachers | 3.89 | 1.05 | 3.67 | 1.00 |
| 6. Source of knowledge for teachers | 4.56 | 0.53 | 4.78 | 0.44 |
| 7. Administrator of programs and policies | 3.56 | 1.01 | 3.00 | 0.70 |
| 8. Evaluator of other teachers | 2.78 | 1.20 | 3.00 | 1.12 |

Figure 4.1 graphically illustrates the very slight changes in the mean ranking roles of Cohort II teachers in this study from before participation (Spring 2003) to after participation in ITS Center experiences (Fall 2006). The greatest changes were in (7) *Administration of programs and policies* (decrease of 0.56), (4) *Generator of new ideas for teachers* (increase of 0.45), and (3) *Catalyst for individual teacher improvement* (increase of 0.44).

Since Likert-type rating scales are ordinal rather than interval data, five-number summaries and percentages (Moore & McCabe, 2003) for ITS Center teachers pre and post are reported. Table 4.2 provides a five-number summary for the pre-ITS experience

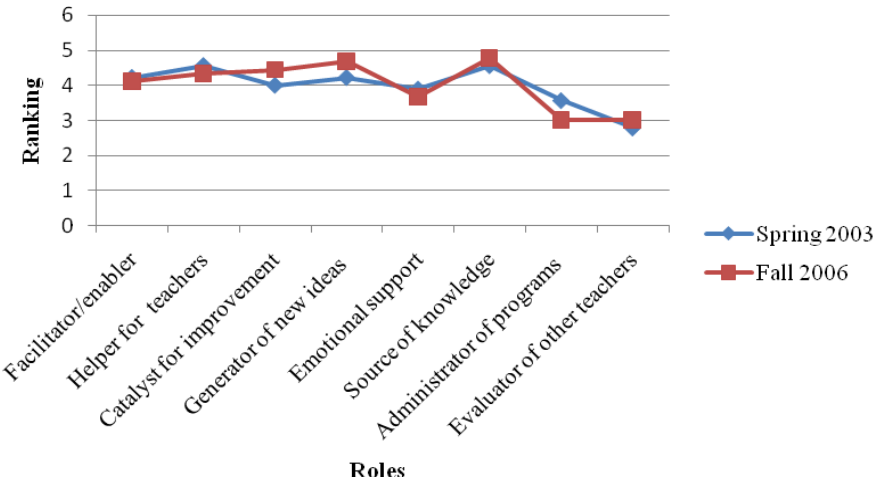


**Figure 4.1** *Change in mean rating for teacher leadership roles from Spring 2003 application to post-ITS experience Fall 2006*

(Spring 2003) and post-ITS experience administration of the survey (Fall 2006). As indicated on both tables, the ITS teachers viewed their leadership roles as supporting classroom teachers helping students learn rather than in formal administrator roles both before and after their ITS experience. When the pre and post means in Table 4.1 are compared to the pre and post medians in Table 4.2, it can be seen that the changes for both the mean and the median were similar except for the role (8) *Evaluator of other teachers* as shown in Figure 4.2. For this role, the mean increased from Spring 2003 to Fall 2006 while the median decreased over the same period. Box-and-whisker plots for the five-number summaries Spring 2003 and Fall 2006 of each of the roles are found in Appendix D. Box-and-whisker plots are useful in data analyses because they show outliers as well as medians and spread, characteristic of the data which are not as obvious in table form.

**Table 4. 2**
**Five Number Summary for Leadership Roles Survey Administered Spring 2003 (Pre) and Fall 2006 (Post)**

| | 1.Facilitator/ enabler | | 2. Helper for teachers | | 3. Catalyst for improvement | | 4.Generator of ideas | | 5.Emotional support | | 6. Source of knowledge | | 7. Administer Programs | | 8. Evaluator | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Minimum | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 4 | 2 | 1 | 1 | 1 |
| 25th %-tile | 3 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 3 | 3 | 1 | 2 |
| Median | 5 | 4 | 5 | 5 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 5 | 3 | 3 | 3 | 2 |
| 75th %-tile | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 3 | 4 |
| Maximum | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 |

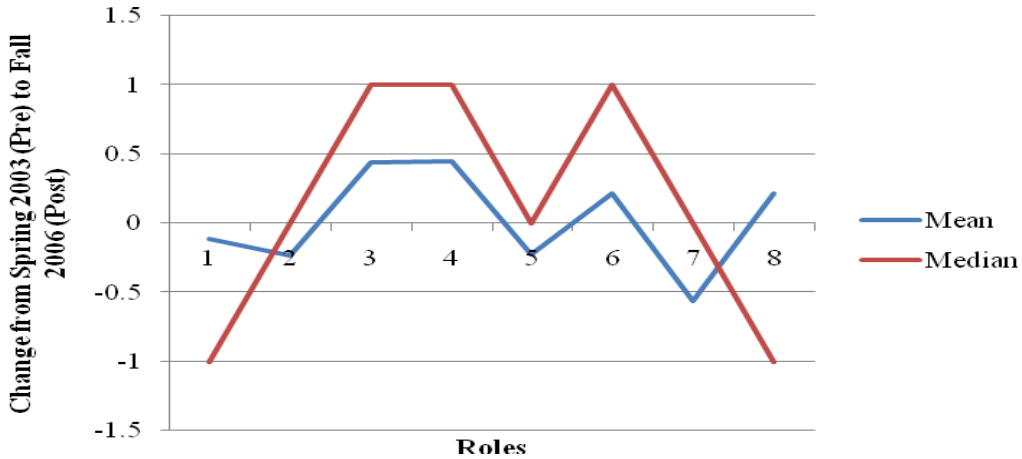


**Figure 4. 2** *Changes in mean and median from Spring 2003 (pre) to Fall 2006 (post) for each leadership role*

The median response for (1) *Facilitator/enabler* decreased from 5 (to a great extent) to 4 (somewhat often), and the variability of the responses decreased from Spring 2003 to Fall 2006, with a single outlier for the post administration of the survey. The interquartile range also decreased on the survey administered after the ITS Center experience.

For the second role *Helper for teachers,* the median and interquartile range remained the same before and after the ITS Center experience. Like the first role, the Fall 2006 survey had a single outlier responding Rarely. Interestingly, the outlier for each of these roles is the same teacher.

In the Spring of 2003, two-thirds (a total of ten) of the teachers responded 4 (somewhat often) to role (3) *Catalyst for individual teacher improvement.* The two teachers who responded 3 (*Sometimes*) and three teachers answered 5 (*To a great extent)* were outliers. After the ITS Center experience, eight teachers responded 5 (*To a great extent*), only three responded 4 (*Somewhat often*), and four responded 3 (*Sometimes*).

On role (4) *Generator of new ideas for teachers,* only the median changed. The minimum, maximum, and interquartile range remained the same from the Spring 2003 and Fall 2006 administrations of the leadership survey.

Unlike the first four roles described, the responses to role (5) *Source of emotional support for teachers* increased in variability from Spring 2003 to Fall 2006. The median and the interquartile range remained the same, but the minimum decreased. No teachers gave this role a rating of 1 (*Not at all*) on the Spring 2003 survey, and one teacher rated this role as a 1 on the Fall 2006 survey.

More than any other role, (6) *Source of knowledge for teachers* decreased in variance from Spring 2003 to Fall 2006. All responses in Fall 2006 were either 4 (*Somewhat often*) or 5 (*To a great extent*). The median response increased from 4 to 5 also.

The five-number summaries are nearly identical for the Spring 2003 and Fall 2006 role of (7) *Administrator of programs and policies*. The only difference seen in this representation is that the minimum changed from 2 (*Rarely*) in Spring 2003 to 1 (*Not at all*) in Fall 2006. This data point is shown as an outlier in Figure 4.3. The outlier teacher for this role different from the outlier teacher in roles 1 and 2.

For the final role (8) *Evaluator of other teachers*, the range from minimum to maximum increased from Spring 2003 to Fall 2006 while the median and interquartile range decreased. In the original administration of the survey, no one reported their role of evaluating other teachers as 5 (*To a great extent*). This changed on the post ITS Center survey even though the median response decreased from 3 (*Sometimes*) to 2 (*Rarely*).

While five-number summaries are widely accepted means of analyzing and reporting ordinal data, they, like mean and standard deviation, are measures of central tendency (Hinkle et al., 1998). This can be adequate for certain studies, especially when the population/sample size is large. However, when the number of participants is small, as in the present study, an examination of percents for each response can lead to greater understanding of "what happened here" (Moore & McCabe, 2003). Another method of examining ordinal data is response frequencies as shown in Table 4.3.

**Table 4. 3**

**Frequency for Each Response for Leadership Roles Survey Administered Spring 2003 (Pre) and Fall 2006 (Post)**

| | 1.Facilitator /enabler | | 2.Helper for teachers | | 3.Catalyst for improvement | | 4.Generator of ideas | | 5.Emotional support | | 6.Source of knowledge | | 7.Administrate programs | | 8.Evaluator | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Not at All | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 5 | 2 |
| Rarely | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 | 2 | 1 | 6 |
| Sometimes | 3 | 2 | 1 | 2 | 3 | 4 | 3 | 1 | 4 | 5 | 1 | 0 | 6 | 7 | 6 | 3 |
| Somewhat often | 3 | 5 | 6 | 3 | 9 | 3 | 6 | 4 | 6 | 4 | 7 | 4 | 3 | 4 | 3 | 3 |
| To a great extent | 8 | 7 | 8 | 9 | 3 | 8 | 6 | 10 | 4 | 4 | 7 | 11 | 3 | 1 | 0 | 1 |

*Activities*

In addition to roles, participants were asked to indicate the extent to which a list of activities matched their current leadership activities. The eight leadership activities are: attend (participate in) program-related meetings; engage in building-level decision making related to curricular, instructional and professional development planning; develop district-level curricular programs; develop curricular/instructional materials; plan building-level staff development activities; develop building-level curricular/instructional programs; meet with principal to discuss principal's concerns and plans for building; and promote implementation of district-level programs. These activities are numbered 9-16 to avoid confusion with the eight roles discussed above. The response choices were the same as for roles: from 1 (*Not at all*) to 5 (*To a very great extent*). The results from the Spring 2003 application survey and the Fall 2006 post ITS Center follow-up survey are shown in Table 4.4.

**Table 4. 4**
**Study Participant Results for Leadership Activities**

| Activities | Spring 2003 | | Fall 2006 | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| 9. Attend program-related meetings | 4.73 | 0.59 | 4.13 | 0.83 |
| 10. Engage in building-level decision making | 4.20 | 0.78 | 4.07 | 0.96 |
| 11. Develop district-level curricular programs | 4.00 | 1.00 | 4.00 | 1.00 |
| 12. Develop curricular/instructional materials | 4.40 | 0.74 | 4.40 | 0.91 |
| 13. Plan building-level staff development activities | 3.33 | 0.98 | 3.73 | 1.39 |
| 14. Develop building-level curricular/instructional programs | 3.73 | 1.03 | 3.93 | 1.33 |
| 15. Meet with principal to discuss principal's concerns for plans for building | 3.53 | 1.30 | 3.80 | 1.21 |
| 16. Participate in formal classroom inquiry | 4.67 | 0.72 | 4.00 | 0.85 |

Smylie and Denny (1990) did not report mean and standard deviation from their sample. Although they used a five-point scale similar to the scale for roles, they reported only rankings for each activity. Thus, Table 4.5 provides the Spring 2003 and Fall 2006 rankings by activity ITS Center teachers. Activities that "tied" are given the same ranking. For example, (11) *Develop district-level curricular programs* and (16) *Participate in formal classroom inquiry* "tied" for fourth place on the Fall 2006 survey. The next ranked activity, (15) *Meet with principal to discuss principal's concerns for plans for building* is listed as sixth rank.

**Table 4. 5**
**Rankings of Leadership Activities from Spring 2003 and Fall 2006**

| | Spring 2003 | Fall 2006 |
|---|---|---|
| 9. Attend program-related meetings | 1 | 2 |
| 10. Engage in building-level decision making | 4 | 3 |
| 11. Develop district-level curricular programs | 5 | 4 |
| 12. Develop curricular/instructional materials | 3 | 1 |
| 13. Plan building-level staff development activities | 8 | 8 |
| 14. Develop building-level curricular/instructional programs | 6 | 6 |
| 15. Meet with principal to discuss principal's concerns for plans for building | 7 | 7 |
| 16. Participate in formal classroom inquiry | 2 | 4 |

Activity (16) *Participate in formal classroom inquiry* was not in the original Smylie and Denny (1990) survey; it was added to the ITS Center application to reflect the focus of engaging teachers in classroom inquiry. The ITS Center teachers in Spring 2003 reported that their top leadership activity was attending meetings. Fall 2003, attending meetings was ranked second. Also on both pre- (Spring 2003) and post- (fall

2006) surveys, (12) *Develop curricular/instructional materials* was ranked near the top. On both administrations, the lowest ranked activities (least descriptive of their activities as teacher leaders) were (13) *Plan building-level staff development activities*, (14) *Develop building-level curricular/instructional programs*, and (15) *Meet with principal to discuss principal's concerns for plans for building*. Figure 4.3 shows comparative ranks, with shorter bars representing higher ranks and longer bars representing lower ranked activities.

As with the leadership roles, mean, standard deviation, and rank only tell part of the story. A five-number summary of minimum, 25$^{th}$ percentile, median, 75$^{th}$ percentile, and maximum is shown in Table 4.6. The minimum decreased on (12) *Develop curricular/instructional materials*, (13) *Plan building-level staff development activities*, and (14) *Develop building-level curricular/instructional programs*, while remaining the same on all other activities. The 25$^{th}$ percentile decreased on (9) *Attend program-related meetings*, (10) *Engage in building-level decision making*, and (16) *Participate in formal classroom inquiry*, while remaining the same on all other activities.

With the small number of participants in this study, a change in one or two responses can impact a five-number summary or box-and-whisker plot (Appendix E). Table 4.7 shows the number and percent of each of the five possible responses given by the 15 participants in Spring of 2003. Table 4.8 gives the numbers and percents for the Fall 2006 administration of the survey.

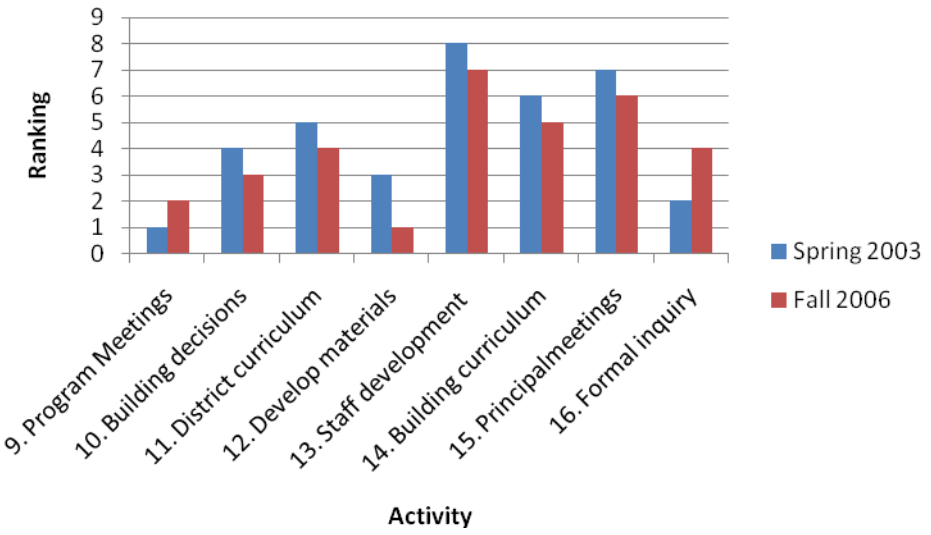


**Figure 4. 3** *Comparative ranking of Spring 2003 (pre ITS Center) and Fall 2006 (post ITS Center rankings of teacher leadership activities. Note that the shorter the bar the higher the ranking*

The changes in the median were mixed. The median increased for (13) *Plan building-level staff development activities,* (14) *Develop building-level curricular/instructional programs,* and (15) *Meet with principal to discuss principal's concerns for plans for building;* decreased for (9) *Attend program-related meetings* and (16) *Participate in formal classroom inquiry*; and remained the same for (10) *Engage in building-level decision making,* (11) *Develop district-level curricular programs*, and (12) *Develop curricular/instructional materials*. The 75$^{th}$ percentile changed only for (13) *Plan building-level staff development activities,* increasing from Spring 2003 to Fall 2006. The maximum score for all activities was 5 (*To a great extent*) for both administrations of the survey. Figure 4.4 indicates the difference between the median and the mean

**Table 4. 6**
**Five-Number Summary of Activities from Spring 2003 and Fall 2006 Leadership Survey**

| | 9. Program meetings | | 10. Building decisions | | 11. District curriculum | | 12. Develop materials | | 13. Staff development | | 14. Building curriculum | | 15. Principal meetings | | 16. Formal inquiry | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Minimum | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 3 | 3 |
| 25th %-tile | 5 | 3 | 4 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 3 |
| Median | 5 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 3 | 4 | 3 | 4 | 3 | 4 | 5 | 4 |
| 75th %-tile | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Maximum | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

**Table 4. 7**
**Frequency of Each Response for Spring 2003 and Fall 2006 Leadership Survey by Activity**

| | 9. Program meetings | | 10. Building decisions | | 11. District curriculum | | 12. Develop materials | | 13. Staff development | | 14. Building curriculum | | 15. Principal meetings | | 16. Formal inquiry | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| Not at All | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 0 |
| Rarely | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 3 | 1 | 1 | 2 | 2 | 1 | 0 | 0 |
| Sometimes | 1 | 4 | 3 | 6 | 4 | 4 | 2 | 1 | 6 | 1 | 2 | 1 | 5 | 3 | 2 | 5 |
| Somewhat often | 2 | 5 | 6 | 2 | 4 | 4 | 5 | 4 | 4 | 6 | 7 | 4 | 2 | 5 | 1 | 5 |
| To a great extent | 12 | 6 | 6 | 7 | 6 | 6 | 8 | 9 | 2 | 5 | 5 | 7 | 5 | 5 | 12 | 5 |

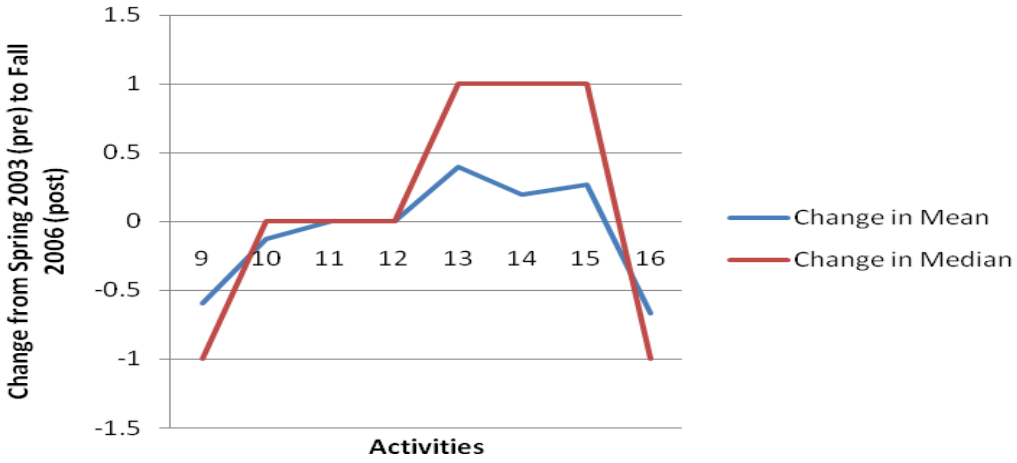


**Figure 4. 4** *Changes in mean and median from Spring 2003 (pre) to Fall 2006 (post) for each leadership activity*

*Group Changes*

Changes occurred for each indicator of leadership roles and leadership activities. The first question many people ask is, "Are these changes statistically significant?" Since each of the indicators use a five-point ordinal scale, a Wilcoxon signed-rank test was used to measure the significance of the pre-post data. As Table 4.8 indicates, only Activity 9, *Attend program-related meetings*, was statistically significant at the $p < .05$ level.

**Table 4. 8**
**Wilcoxon Signed-Rank Test Results**

| Indicator | Significance (2-tailed) |
|---|---|
| 1. Facilitator/enabler | 1.00 |
| 2. Helper for teachers | 0.61 |
| 3. Catalyst for individual teacher improvement | 0.25 |
| 4. Generator of new ideas for teachers | 0.08 |
| 5. Source of emotional support for teachers | 0.46 |
| 6. Source of knowledge for teachers | 0.10 |
| 7. Administrator of programs and policies | 0.51 |
| 8. Evaluator of other teachers | 0.76 |
| 9. Attend program-related meetings | 0.04* |
| 10. Engage in building-level decision making | 0.59 |
| 11. Develop district-level curricular programs | 0.86 |
| 12. Develop curricular/instructional materials | 0.85 |
| 13. Plan building-level staff development activities | 0.31 |
| 14. Develop building-level curricular/instructional programs | 0.47 |
| 15. Meet with principal to discuss principal's concerns for plans for building | 0.36 |
| 16. Participate in formal classroom inquiry | 0.06 |

* $p < .05$

The use of scales to measure attitudes as conceived by Thurstone (1929; 1929) and modified by Likert (1932) called for multiple indicators that are combined to measure a single attitude or characteristic. Thus, the eight indicators for leadership roles and the eight indicators for leadership activities were summed for each of the 15 participants for the Spring 2003 application responses (prerole and preactivity) and the Fall 2006 follow-up survey (postrole and postactivity). For leadership roles, the median increased from 32 to 33 and the range decreased slightly, but the interquartile range

increased from 7 to 10 as shown in Table 4.9 and Figure 4.5. For leadership activities, the median increased one point, just as the roles did, and the interquartile range increased slightly. However, the interesting change was in the range. As Figure 4.6 indicates, the minimum response for leadership activities decreased from 25 to 18. This will be discussed further in Chapter V Conclusions. A Wilcoxon signed-ranks test of significance (2-tailed) found that the asymptotic significance for leadership roles was 1.000 and for leadership activities was 0.842.

**Table 4. 9**
**Five-Number Summary of Pre- and Posttest for Participants**

| | Leadership Roles | | Leadership Activities | |
|---|---|---|---|---|
| | Spring 2003 | Fall 2006 | Spring 2003 | Fall 2006 |
| Minimum | 21 | 22 | 25 | 18 |
| $25^{th}$ percentile | 27 | 28 | 27 | 26 |
| Median | 32 | 33 | 33 | 34 |
| $75^{th}$ percentile | 34 | 38 | 36 | 37 |
| Maximum | 39 | 39 | 40 | 39 |

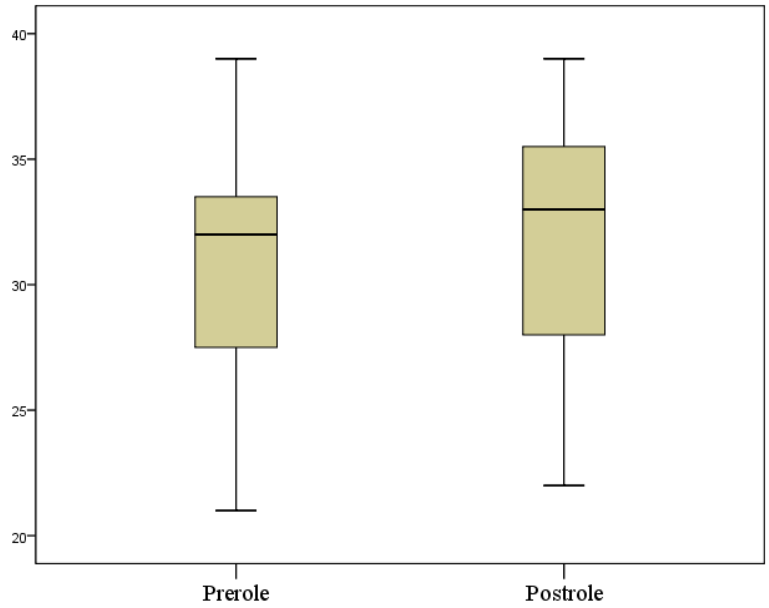


**Figure 4. 5** *Box-and-whisker plots for Leadership Role scores from Spring 2003 (Prerole) and Fall 2006 (Postrole) for this study population*

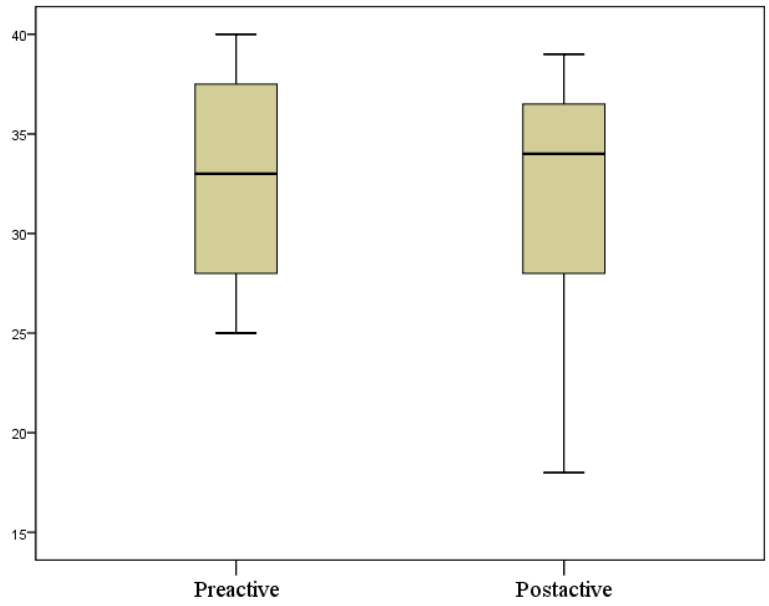


**Figure 4. 6** *Box-and-whisker plots for Leadership Activity scores from Spring 2003 (Prerole) and Fall 2006 (Postrole) for this study population*

Sums of indicators are more often treated as interval rather than ordinal data, thus mean and standard deviation are shown in Table 4.10. As with the nonparametric analysis, the difference is not statistically significant. In a paired samples t-test, the 2-tailed significance for leadership role was p = .730 and for leadership activities was p = .812.

**Table 4.10**
**Mean and Standard Deviation of Pre- and Posttest for Participants**

| | Leadership Roles | | Leadership Activities | |
|---|---|---|---|---|
| | Spring 2003 | Fall 2006 | Spring 2003 | Fall 2006 |
| Mean | 21 | 22 | 25 | 18 |
| Standard Deviation | 5.03 | 5.40 | 4.95 | 6.53 |

*Summary*

The teacher participants in this study rated (6) Source of knowledge for teachers as their top role as a group after the ITS Center experience followed by (4) Generator of new ideas for teachers. Each of these roles were rated quite highly and align with the ITS Center focus to increase teachers' science content knowledge and pedagogical content knowledge. The ITS Center was also designed to increase teachers' knowledge and skills related to the use of information technology used in science research. These goals also match the roles of leading though knowledge and idea generation. The lowest scoring roles were (7) Administrator of programs and policies and (8) Evaluator of other teachers. These roles are traditionally seen as belonging to campus administrators rather than teachers and were not addressed in the ITS Center experience. Even in these lowest-

rated roles, the ITS Center teacher participants demonstrated a higher rating than might be expected of classroom teachers.

The primary activity of the ITS Center teacher-participants was to develop curricular/instructional materials. This goal matches with their identified primary role as a source of knowledge for teachers. The second highest activity was to attend program-related meetings followed closely by engaging in building-level decision making. These two activities tend to be linked because many building-level decisions are made in program-related meetings or as a consequence of program-related meetings. These activities also align with the role of being a generator of new ideas for teachers since program-related meetings are a mechanism for sharing ideas.

As a group, the changes in roles and activities were not statistically significant except for (9) Attend program-related meetings which decreased from a median of 5 (*To a very great extent*), with 12 of the 15 teachers giving that response, to a median of 4 (*Somewhat often*). However, as indicated in the research, many factors support or oppose teacher leadership; participation in a professional development program is just one piece. While the *group* did not demonstrate large changes in leadership roles and activities, individuals did. This individual change is discussed in the section on Research Question 2.

## Research Question 2

Question 2 asked: Of the teachers who reported the greatest increase in their leadership roles and activities, what aspects of their science education leadership experience do they identify as contributing to their change in leadership? This assumes

that changes in leadership occurred. As shown in the discussion of results for Question 1, as a *group*, very little change occurred in Cohort II teacher-participants with regard to leadership roles. However, as *individuals* quite a bit of change occurred for all but four of the participants. The increase in leadership roles and activities for six of the teacher participants was, for all practical purposes, cancelled out by the decrease in leadership roles and activities by five other participants. In this section, change by individual participants will be examined, then changes in two of the participants and the association of these changes to their ITS Center experience is discussed. Possible reasons for no change or decrease in leadership roles and activities are discussed in Chapter V.

*Individual Changes and Purposive Sampling*

During the design phase of this study, it was determined that a purposive sample of two to four teachers demonstrating the greatest increase in leadership would be the respondents for Question 2. It was determined that only teachers in schools that are large enough to have multiple science and mathematics teachers would be considered, since it is difficult to demonstrate leadership when you are the only science teacher in the school. To determine increase in leadership, responses on the Spring 2003 and Fall 2006 Teacher Leadership Roles Survey were collected. Numbers were assigned for each response as described under the results of Question 1. Scores were summed for each teacher for the two parts, Roles and Activities, as described under Group Changes above.

Each participant across the three cohorts in the ITS Center was assigned a unique PKID number by the ITS Center evaluation team. All evaluation responses across the

six years of funding were coded by this PKID number. Scores by teacher for each section of the survey were calculated. Changes in scores on Roles and Activities for each Teacher were computed. Since there were eight questions about Role and eight questions about Activities, the maximum possible score for each category was 40. Scores and percent of possible score (score/40) are shown in Table 4.11 along with change in scores from Spring 2003 to Fall 2006. Only one teacher, PKID 112, scored a "40" on Leadership Activities on the Spring 2003 survey.

**Table 4.11**
**Individual Change in Leadership Roles and Leadership Activities for the 15 Individuals in the Present Study Population**

| | 2003 | | 2006 | | Total Change | |
|---|---|---|---|---|---|---|
| PKID | Leadership Roles (%) | Leadership Activities (%) | Leadership Roles (%) | Leadership Activities (%) | Role Change | Activity Change |
| 9 | 39 (98%) | 37 (93%) | 35 (88%) | 38 (95%) | -4 | 1 |
| 36 | 29 (73%) | 27 (68%) | 25 (63%) | 23 (58%) | -4 | -4 |
| 39 | 28 (70%) | 28 (70%) | 37 (93%) | 39 (98%) | 9 | 11 |
| 44 | 26 (65%) | 25 (63%) | 29 (73%) | 32 (80%) | 3 | 7 |
| 53 | 37 (93%) | 38 (93%) | 33 (83%) | 35 (88%) | -4 | -3 |
| 74 | 33 (83%) | 31 (78%) | 37 (93%) | 33 (73%) | 4 | 2 |
| 84 | 33 (83%) | 31 (78%) | 35 (88%) | 34 (85%) | 2 | 3 |
| 91 | 27 (68%) | 34 (85%) | 32 (80%) | 37 (93%) | 5 | 3 |
| 106 | 21 (53%) | 27 (68%) | 34 (85%) | 33 (73%) | 13 | 6 |
| 110 | 26 (65%) | 28 (70%) | 22 (55%) | 22 (55%) | -4 | -6 |
| 112 | 32 (80%) | 40 (100%) | 36 (90%) | 36 (90%) | 4 | -4 |
| 155 | 29 (73%) | 39 (98%) | 23 (58%) | 18 (45%) | -6 | -21 |
| 166 | 38 (95%) | 38 (95%) | 39 (98%) | 38 (95%) | 1 | 0 |
| 179 | 34 (85%) | 33 (73%) | 27 (68%) | 26 (65%) | -7 | -7 |
| 192 | 33 (83%) | 33 (73%) | 29 (73%) | 38 (95%) | -4 | 5 |

Because several of the teachers applying to the ITS Center were already involved in formal leadership positions and reported leadership roles and activities, finding teachers whose leadership increased after their ITS Center experience was impacted by a ceiling effect, discussed further in Chapter V. However, when Role, Activity, and total change was charted (Figure 4.7), two teachers—PKID 39 and 106—stood out as increasing far more than the others. Some teachers, especially PKID 155, decreased in their Leadership Roles and Activities scores. Since the teacher-participants demonstrated such a wide range of change in teacher leadership and activities, data external to the present study were examined. Facet Innovations, the external evaluators for the ITS Center, conducted a follow-up, open-ended questionnaire in Fall 2006 at the same time the post leadership survey was administered. Results from the Facet Innovations survey indicated that all of the teachers demonstrating an increase of five or more points in the Leadership Survey were in formal teacher leadership roles, primarily science or mathematics department heads. The three teachers with the greatest decrease in scores, PKID 110, 179, and 155 changed school campuses or districts after their ITS Center experience. However, even these teachers indicated on their Facet Innovations survey that they are using the science, information technology, and classroom inquiry that they experienced in the ITS Center in their current positions.

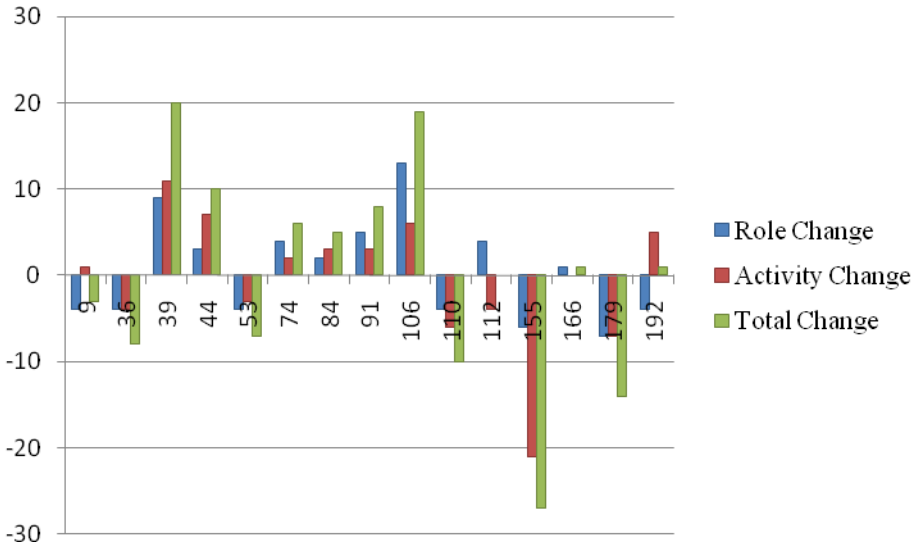


**Figure 4. 7** *Role, activity, and total change for each of the 15 teachers in the present study population. PKID numbers are shown on the 0 axis*

With any Likert-type scale, there is a concern with a ceiling effect; that is, respondents choose the highest available response (Clason & Dormody, 1994). This was especially a concern when teachers were asked to respond to leadership roles and activities as a part of their application to participate in the ITS Center. It is highly likely that two of the fifteen teacher participants in this study, teachers PKID 9 and 166, did not demonstrate change in teacher leadership because of a ceiling effect. These two teachers rated most of their roles and activities as 5 (*To a very great extent*) on the Spring 2003 survey. They each chose a rating of 5 for 12 of the questions and a rating of 4 for the rest. PKID 9 decreased slightly on role, increased slightly on activities, and decreased overall. PKID 166 increased from a 4 to a 5 on role (8) Evaluator of other teachers. For leadership activities, PKID 166 increased from 4 to 5 on (11) Develop

district-level curricular programs and decreased from 5 to 4 on (12) Develop curricular/instructional materials and (14) Develop building-level curricular/instructional programs, for a next change of zero.

The two teachers reporting the greatest increase in roles and activities were PKID 39 and 106. Information from their ITS Center applications indicated that PKID is a White male high school mathematics teacher with 17 years teaching experience when he applied to the ITS Center. PKID 106 is a Hispanic female middle school science teacher with 3 years experience as of 2003. Both teachers are from (different) suburban school districts just outside of two different major Texas metropolitan areas. Since they met the requirement of school size and from very different backgrounds and regions of the state, they were contacted by phone and agreed to participate in the interviews and observations involved in data collection for Question 2. IRB consent was obtained from the teachers and their administrators, and observation dates were agreed upon.

PKID 106 was designated Ms A, and PKID was designated Mr. B. The change in their responses by indicator is shown in Table 4.12. The indicator that they each reported the greatest gain was in (8) *Evaluator of other teachers*, which was related to their formal leadership positions. They also both reported increasing from 2 (*Rarely*) to 4 (*Somewhat often*) on role (7) Administrator of programs and policies and from 3 (*Sometimes*) to 5 (*To a very great extent*) on activity (14) *Develop building-level curricular/ instructional materials*. They also both increased on activity (11) *Develop district-level curricular programs.*

**Table 4.12**
**Teacher Leadership Roles Survey Pre and Post Responses by Indicator for Ms A and Mr. B**

| Indicator | Ms. A | | Mr. B | |
|---|---|---|---|---|
| | Pre | Post | Pre | Post |
| 1. Facilitator/enabler | 2 | 4 | 4 | 5 |
| 2. Helper for teachers | 3 | 5 | 5 | 5 |
| 3. Catalyst for individual teacher improvement | 4 | 4 | 4 | 5 |
| 4. Generator of new ideas for teachers | 3 | 5 | 4 | 5 |
| 5. Source of emotional support for teachers | 3 | 3 | 3 | 4 |
| 6. Source of knowledge for teachers | 3 | 5 | 5 | 5 |
| 7. Administrator of programs and policies | 2 | 4 | 2 | 4 |
| 8. Evaluator of other teachers | 1 | 4 | 1 | 4 |
| 9. Attend program-related meetings | 5 | 4 | 4 | 5 |
| 10. Engage in building-level decision making | 3 | 3 | 3 | 5 |
| 11. Develop district-level curricular programs | 2 | 4 | 3 | 5 |
| 12. Develop curricular/instructional materials | 5 | 5 | 3 | 5 |
| 13. Plan building-level staff development activities | 3 | 5 | 4 | 5 |
| 14. Develop building-level curricular/instructional programs | 3 | 5 | 3 | 5 |
| 15. Meet with principal to discuss principal's concerns for plans for building | 3 | 4 | 3 | 5 |
| 16. Participate in formal classroom inquiry | 3 | 3 | 5 | 4 |

*Ms. A*

*Setting.* Ms. A is a middle school teacher in a large, suburban school district in a major metropolitan area of Texas. This school district (School District A) has experienced rapid growth in student population over the last 20 years, with seven bond elections (six passed, one failed) in that time period. School enrollment during this time has grown from 1% in 1989-1990 to 5.59% in 2005-2006 as shown in Figure 4.8(Texas Education Agency, 2008). Google Earth™ satellite images of School District A from 2004 show much of the district as undeveloped brush/ woodlands. Several

neighborhoods appeared to be under construction with streets laid out and land cleared, but few houses built. During the site visit in May 2007, this researcher drove through the area. Developments that were only started in 2004 were fully built, and homes were nearly 100% occupied. These single family homes were primarily brick and frame three- and four-bedroom houses with fenced back yards and "builder landscaping" of a grass, a tree or two about one inch in diameter, and a few small bushes. Shopping centers and strip malls were in various stages of construction and occupancy in places that were tree covered on the 2004 satellite images. Streets wound through areas that had shown no signs of development.

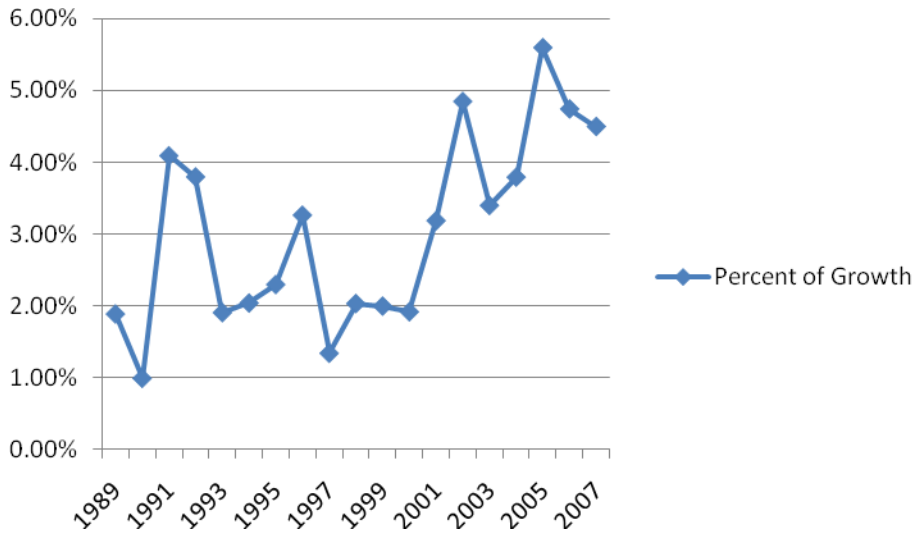


**Figure 4.8** *Annual percentage of growth in student population in School District A from 1988 to 2007*

Conversations with patrons and employees in local gas station/convenience stores, coffee shops, and restaurants revealed that many of the newcomers to the area

were transplants from California lured by the comparatively low real estate prices and growing job market. One newcomer stated that she and her husband had sold their two-bedroom house in California and had paid cash for a four bedroom house in the Middle School A attendance zone. Although some of the newcomers were retirees looking for a more moderate climate than the Midwest and Rust Belt, most were families with school-aged children. Nearly all the newcomers were from out of state. These observations were supported by the attendance clerk and counselors at Middle School A who reported that most of the new enrollees were from out of state.

Middle School A opened its doors in August 2004 with an enrollment of 1,037 sixth-, seventh-, and eighth-grade students (Texas Education Agency, 2008). Three years later, the student enrollment had risen to 1,438, and three portables (six classrooms) had been installed with more planned for the next year. Table 4.13 compares racial, ethnic, and economic diversity of District A and Middle School A to the statewide public school population. Both District A and Middle School A have student populations that are more than 50% Hispanic, which is greater than the total state percentage. The district and school have a smaller percentage of economically disadvantaged and English Language Learners than the state as a whole. Middle School A has an African American population comparable to that of the state, but the district has a smaller percentage.

When the school opened, the daily schedule was a block schedule with four 90-minute periods meeting every other day. Teachers taught three periods a day and met with academic teams (e.g., science, mathematics) on Monday, Wednesday, and Friday

and grade level teams on Tuesday and Thursday during the fourth 90-minute period. During these team meetings, teachers planned collaborative and interdisciplinary instructional units and pursued joint professional development activities.

**Table 4.13**
**Student Demographics in Texas, District A, and Middle School A from 2004 to 2008**

| | African American | Hispanic | White | Native American | Asian/ Pacific Island. | Economically Disadvantaged | English Language Learners |
|---|---|---|---|---|---|---|---|
| 2004-2005 | | | | | | | |
| State | 14.2% | 44.7% | 37.7% | 0.3% | 3.0% | 54.6% | 15.6% |
| District | 7.4% | 60.1% | 29.5% | 0.3% | 2.7% | 47.9% | 6.3% |
| Middle School A | 12.9% | 50.0% | 35.0% | 0.2% | 1.9% | 36.0% | 1.0% |
| 2005-2006 | | | | | | | |
| State | 14.7% | 45.3% | 36.5% | 0.3% | 3.1% | 55.6% | 15.8% |
| District | 8.0% | 61.2% | 27.6% | 0.3% | 2.9% | 49.5% | 6.5% |
| Middle School A | 14.2% | 50.9% | 32.1% | 0.4% | 2.3% | 35.4% | 1.4% |
| 2006-2007 | | | | | | | |
| State | 14.4% | 46.3% | 35.7% | 0.3% | 3.3% | 55.5% | 16.0% |
| District | 8.0% | 62.3% | 26.2% | 0.3% | 3.2% | 46.3% | 6.7% |
| Middle School A | 13.9% | 54.5% | 29.1% | 0.5% | 2.2% | 34.1% | 5.8% |
| 2007-2008 | | | | | | | |
| State | 14.3% | 47.2% | 34.8% | 0.3% | 3.4% | 55.3% | 16.7% |
| District | 7.8% | 63.1% | 25.4% | 0.3% | 3.3% | 47.4% | 6.7% |
| Middle School A | 13.9% | 56.7% | 26.0% | 0.6% | 2.9% | 36.2% | 1.4% |

When the school population rose to 1,400, the schedule had to be changed to eight 45-minute classes meeting every day with teachers teaching seven periods and having one 45-minute conference period. Since the state requires that teachers have a 45- minute unscheduled conference period at least four days a week, the common planning and professional development time has all but disappeared.

*Ms. A's background.* Although Ms. A played school, primarily in the role as the teacher, with her friends growing up, she had no intention of becoming a teacher when she went to college. She majored in a multi-disciplinary science combination of biology and chemistry with a vague plan of entering the medical field. However, she signed up for a course called Introduction to Teaching. During this class, she "fell in love with teaching, and pedagogy, and lesson planning, and everything that revolved around the education field," and added teacher certification courses to her science degree.

Ms. A is a native of the region where she teaches. She began her teaching career as a high school science teacher in a nearby school district. During her first year of teaching, Ms. A began work on a graduate degree in instructional technology at Regional University One. This led to a one year position with the university as a training coordinator. At the end of the year, Ms. A took a teaching position in District A as a middle school science teacher at Middle School $A_{-1}$. During this time, Ms. A sought professional development opportunities, especially experiences relating to technology. District A purchased Vernier software, probes, and sensors while Ms. A was teaching at Middle School $A_{-1}$. Ms. A and several of her fellow middle school science teachers from across District A attended a program at Regional University Two to prepare them to integrate the Vernier equipment into their science program. One of the presenters for the Regional University Two program was a member of Cohort 1 of the ITS Center. In addition to providing instruction about the use of technology in middle school science, this presenter shared information about opportunities available through the ITS Center. Ms. A was interested in the opportunities for professional growth and graduate credit.

She applied to the ITS Center and was accepted into Cohort II. Ms. A taught science at Middle School $A_{-1}$ for four years. She transferred to Middle School A one year after it opened.

*Ms A's ITS experience.* Ms. A began her ITS Experience in the Summer of 2003. Her science team was related to her undergraduate major. Although the science content in the ITS team activities was familiar to Ms. A, she did not feel that it was relevant to her eighth-grade science curriculum. Ms. A stated that in School District A, she did not have the freedom to change the content in her science classes because of the district benchmark tests. However, she did have the ability to change the way content was presented. Her Instructional Framework modified a laboratory exercise she taught each year to use the Vernier probes to collect data and to use the calculators to display graphs of the data. The Practitioner Research Plan compared student learning in classes using the Vernier probes and calculators to classes in which students collected the data on paper and drew their own graphs to represent the data. She found that both groups understood the science content equally well. However, the groups using the probes and graphing calculators better understood what the variables were and could better describe the changes over time that occurred during the experiment. Ms. A has applied her Instructional Framework in her own science classes as well as using this experience as a basis for workshops she conducts for science teachers in her district.

*Ms A's current leadership.* Ms. A defines a teacher leader as "someone who takes the initiative to bring new ideas and share those ideas and engage learning at a professional level." She is currently in a formal teacher leadership role. She is

considered a classroom teacher by Middle School A, but her role is to integrate the middle school Technology Applications standards of the Texas Essential Knowledge and Skills (TEKS) (Texas Education Agency, 1998) into core (English, mathematics, science, and social studies) classes in order to ensure that all students have been taught all of the middle school Technology Applications TEKS by the time they leave eighth grade. Texas middle schools are required to teach these TEKS to all students, but "districts have the flexibility of offering technology applications (computer literacy) in a variety of settings, including a specific class or integrated into other subject areas" (Texas Education Agency, 1998). School District A has chosen to integrate these TEKS into core content classes. Therefore, Ms. A is responsible for ensuring that all TEKS are covered.

Ms. A fulfills this role in a variety of ways. One means is to directly teach units to students that integrate course content with the technology. During the site visit by this researcher, Ms. A was in the middle of teaching a unit in several sections of eighth-grade mathematics. Students were working in teams to produce tutorials for fellow students on "difficult" mathematics content as defined by results on the Texas Assessment of Knowledge and Skills (TAKS). Students used various software packages to create tutorials that could be captured and made available for students and their parents through the Middle School A website. Through this unit, students gained a deeper understanding of targeted mathematics content while developing skill with using selected technology applications. Ms. A reports that this type of unit is usually planned jointly by Ms. A and the content teacher. When the unit is taught to several classes, Ms. A usually teaches the

first and second period to model the use of the technology and to deal with any technology “bugs”. Then the content teacher teaches the rest of the periods, with Ms. A available to provide technology support.

Teachers in District A are required to participate in 30 hours of professional development each year. Some of these hours are district-mandated content based on grade level and content area. However, 12 of these required hours are “teacher choice.” Ms. A provides some of the teacher choice professional development for the Middle School A faculty members. This professional development includes topics such as how to use the electronic grade book and develop teacher web pages as well as how to integrate technology into the curriculum using resources such as Google Earth and Audacity™. Teachers may choose topics and time of day, either during their conference period or before/after school. Teachers are also offered more in-depth technology integration professional development through district-wide summer programs. Ms. A attended these summer workshops before and during her ITS Center experience. Since completing her ITS Center program, she leads sessions each summer.

In addition to providing campus and district professional development, Ms. A has presented at state and national conferences on technology integration. These conferences are for science teachers and supervisors from all levels, middle school teachers and administrators from all content areas, and for all educators involved in technology use and integration in the schools. Several of these presentations have been made in partnership with a fellow participant of ITS Cohort II. This fellow participant was a classroom teacher during the ITS Center experience but has gone on to work on

educational outreach for a public agency. Presentations include both "how to" tutorials on using specific equipment such as the Vernier probes and workshops on fully developed curriculum units for specific content.

Since Ms. A teaches at a relatively new middle school with administrators who are relatively new to the district, her administrators were unable to provide any information about Ms. A's growth as a teacher leader. Although the assistant principal who is Ms. A's immediate supervisor did not know anything about Ms. A's participation in the ITS Center, she described Ms. A as "knowledgeable, willing to work with diverse people, and someone who this campus depends (sic)." Ms. A has also been appointed to the Principal's Advisory Board at Middle School A. In this role Ms. A said, "We share ideas and brainstorm and see what's working well now and what we can change for the upcoming year." This advisory board plays a role in setting the professional development agenda for the campus.

*Impact of ITS Center experience.* Ms. A credits her ITS Center participation as being a part of the reason she was given her current leadership position. The science supervisor at her previous school and the science and technology coordinators at the district level were all aware of her participation. Ms. A's name was put forward for her current leadership position by the science supervisor based on Ms. A's formal coursework and her demonstrated leadership activities. Her application for her current leadership position included her ITS Center certificate. During her meeting with the principal at Middle School A, she "did talk a lot about the ITS program in the interview,

and how I did focus on that particular area. That's pretty much what led me into the higher need of wanting to work in this field of integration and technology."

*Role of ITS Center experience*. Ms. A feels that participating in the ITS Center benefited her both professionally and personally. The impact of the ITS Center leadership certificate is discussed above. Although Ms. A had difficulty recalling the name of her science project team and the Texas A&M faculty involved, she reported that the ITS Center experience made a profound difference in her understanding of the nature of science, science curriculum, and science pedagogy. Ms. A stated that as a result of her work on her science team:

> I think I had a better understanding of needs and nature of science, just the basic inquiry in science. When you are going through school and your college courses, a lot of that basic inquiry and the science process or the scientific process is kind of like pushed to the side to get everything done that you have to get done. So in that course, we were able to play and explore and do that scientific process again.

Although the science content of the project team was above the middle school level, Ms. A reported that the "a-ha" moments she experienced during the labs encouraged her to change the structure of the labs in her classroom from a "cook-book" to encouraging higher-order thinking. The use of real-time data in her science team led her to develop a lab based on air quality data during the Mexico fires of 2005.

Ms. A stated one of the things she gained from her ITS Center experience is that technology integration can be used as a mechanism for providing differentiated instruction. She said, "The integration of technology is helping these students learn

using their learning style." She also found that using technology was motivating; "if you put a group of students in front of a computer they are all intrigued, and they are all involved in whatever lesson you are giving as far as there being some sort of technology, hands-on."

Ms. A felt that the structure of the ITS Center experience was important in shaping her leadership development. During both summers, participants worked with their science teams in the mornings and with the education teams in the afternoon. For Ms. A, the most important aspect of the ITS Center structure was the team work. Within her science team, ITS Center participants were further subdivided into groups working on common science tasks. Ms. A said,

> The way we were grouped together I think we had a good dynamic…. There was another teacher in our group. She was actually a science director or something of that nature …. She and I communicated a lot. She shared a lot of good ideas. I saw her leadership skills in our communication. I think I grew from working with people who were already in leadership roles.

In the afternoon teams, the important person to Ms. A was the Campus Resource Person. Ms. A described this person's role:

> The one thing that I really enjoyed was having a mentor for our group. And that they didn't keep us in the large group but broke us up into smaller groups to work on our framework and to work on our paper. We had somebody who was giving us immediate feedback after we would write our drafts and submit it to them. Then they would give us comments and feedback to give right back.

When asked what components of the ITS Center should be replicated in similar centers, Ms. A said:

> As far as leadership, I think having a diverse group of colleagues to work with definitely helped. Like I said yesterday, with the people that were in my particular group, there were not only teachers, but district leaders and regional leaders as well. So having that broad group or range of professionalism really helps enlighten everybody as to what was going on at each level. And in a leadership role, it is important to see everything, not just one particular portion.

Ms. A also recommended having participants from across the state, not just from a single campus or school district; she stated, "We need to look at what other people are doing and what is working outside of our district."

The value of these mentoring relationships is supported in the literature based on the medical education model of near-peer mentoring (Desai et al., 2008; Lockspeiser, O'Sullivan, Teherani, & Muller, 2008; Zemke & Elger, 2005). A near-peer mentor is someone with similar background who has recently completed the stage of learning of the person being mentored (mentee). The mentor and the mentee share a similar knowledge base, or a ''cognitive congruence,'' which allows the mentors to use language that their mentees understand and to explain concepts at an appropriate level (Lockspeiser et al., 2008, p. 362).

For the afternoon (education) portion of the ITS summers, Ms. A felt that the structured requirements of the first summer helped. She said, "The first summer helped out more having those sessions in the afternoon where we all got together to reflect on

what we were doing in our morning sessions and to get some guidance to develop our framework." The afternoon sessions in the second summer were less structured. Ms A said that this was beneficial "because we had a product that we had to create, so having that work time and the Campus Resource Person was helpful."

Ms. A also felt that the two-year structure of the ITS Center contributed to her leadership development. The continued engagement with ITS Center faculty and graduate students promoted reflection and self-examination. In terms of the requirements for the Instructional Framework and the Practitioner Research Plan, Ms. A said,

> I was pleased that I had an end product that was a product that reflected what I had taken from the class and created in my framework, then attempted in my classroom, then I was actually able to go back and evaluate it, make adjustments, then draw data and conclusions from that. In the classroom today, we don't get those opportunities because of time. So having the opportunity to do that over the summer and actually have guidance to do that was beneficial.

Ms. A is using the iterative process of developing an instructional intervention, implanting the intervention, and evaluating the effectiveness with a study group at Middle School A.

Ms. A believed that the ITS Center experience was directly related to her leadership development. She responded on a survey, "My experiences with ITS allowed me to develop and create integrated learning experiences for my students. These

integration lessons landed me in the position to support other teachers with integration adventures."

*Mr. B*

*Setting.* Mr. B also teaches in a suburban school district. However, unlike Ms. A's school district which exists only because of its proximity to a major city, Mr. B teaches in a town that has existed independent of the nearby city for more than 125 years. School District B grew at a moderate pace until it was absorbed in the outward growth of the nearby metropolitan area after 2000 as shown in Figure 4.9 (Texas Education Agency, 2008). Since District B is smaller than District A, the percentage growth is somewhat misleading. For example in 1990, District A grew by 494 students (1%), and District B grew by 459 students (4.49%). However, the big increase in both districts after 2000 resulted in bond issues and building programs that had difficulty keeping pace with growth.

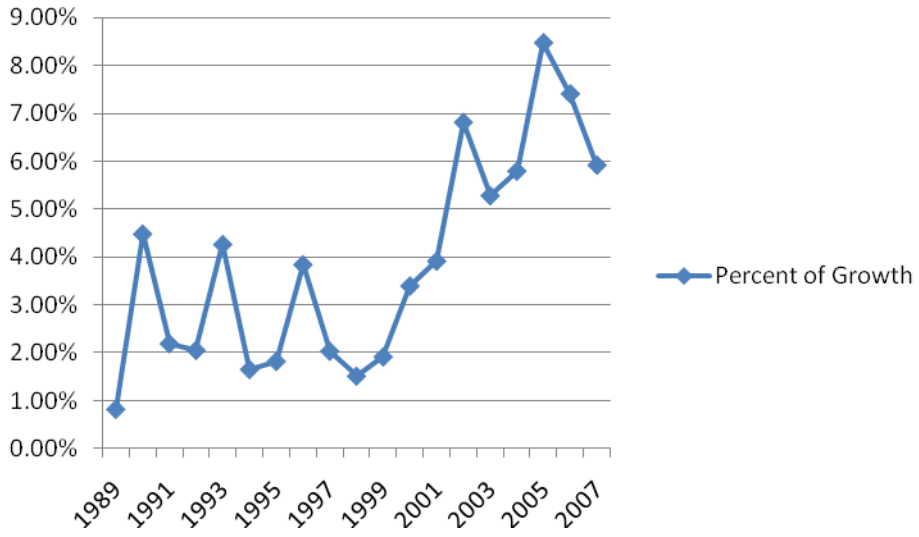


**Figure 4. 9** *Annual percentage of growth in student population in School District A from 1988 to 2007*

Mr. B is a high school mathematics teacher. B High School is the original high school in the old part of town. The current building opened in 1957 and served as the only high school in School District B until 1991 when the campus was closed for remodeling. Mr. B. came to B High School when it re-opened in 1992 and has taught mathematics in the same classroom ever since. When Mr. B began teaching in his current classroom, the students at B High School were 78.1% White, 11.8% Hispanic, and 8.3% African American; and 16.2% were economically disadvantaged. As Table 4.14 shows, the campus has increased in the percentage of minority and economically disadvantaged students (Texas Education Agency, 2008). B High School attendance zone contains nearly the entire old town and the area west of town. While this area has some new development, most of the growth is to the east and south of town in other high school attendance zones.

**Table 4.14**
**Student Demographics in Texas, District B, and B High School from 2004 to 2008**

| | African American | Hispanic | White | Native American | Asian/ Pacific Islander | Economically Disadvantaged | English Language Learners |
|---|---|---|---|---|---|---|---|
| 2004-2005 | | | | | | | |
| State | 14.2% | 44.7% | 37.7% | 0.3% | 3.0% | 54.6% | 15.6% |
| District | 11.8% | 28.0% | 57.5% | 0.6% | 2.1% | 38.2% | 15.1% |
| B High School | 11.3% | 24.4% | 60.5% | 0.8% | 2.9% | 29.7% | 10.4% |
| 2005-2006 | | | | | | | |
| State | 14.7% | 45.3% | 36.5% | 0.3% | 3.1% | 55.6% | 15.8% |
| District | 12.6% | 28.3% | 56.1% | 0.7% | 2.3% | 37.1% | 15.5% |
| B High School | 15.0% | 27.0% | 53.9% | 1.1% | 3.1% | 35.1% | 11.3% |
| 2006-2007 | | | | | | | |
| State | 14.4% | 46.3% | 35.7% | 0.3% | 3.3% | 55.5% | 16.0% |
| District | 12.2% | 29.5% | 55.3% | 0.7% | 2.3% | 38.0% | 15.5% |
| B High School | 14.3% | 30.6% | 50.9% | 1.0% | 3.1% | 39.7% | 10.6% |
| 2007-2008 | | | | | | | |
| State | 14.3% | 47.2% | 34.8% | 0.3% | 3.4% | 55.3% | 16.7% |
| District | 12.2% | 29.9% | 54.7% | 0.7% | 2.5% | 37.6% | 15.4% |
| B High School | 14.8% | 32.4% | 48.8% | 0.9% | 3.1% | 42.1% | 11.8% |

B High School is located on a residential street a few blocks off of a major thoroughfare. Massive trees arch over the streets surrounding the school. Most of the homes in the neighborhood around the school were built before World War II, with some dating from the early 20th Century. The homes in the immediate vicinity are small and well-maintained but not restored. Several small apartment complexes line the street behind the school. A few blocks south is the Historic District which includes larger single-family homes built in the early 1900s. Nineteen of these homes have been designated historic landmarks. Most of these homes have been restored following the guidelines for the National Register of Historic Places.

B High School is on an A-B block schedule with eight 90-minute blocks over two days (four blocks each day). Most teachers teach three blocks each day with 90 minutes for conference/planning. Department heads teach two blocks each day. The school day runs from 8:50 am to 3:50 pm. This allows teachers to provide tutoring both before and after school to accommodate students' extracurricular and work schedules.

*Mr. B's background.* Mr. B grew up in the Midwest. Following in his father's footsteps, Mr. B entered a large Midwestern university planning to be an electrical engineer. Three years into his degree, Mr. B became disillusioned with engineering, transferred to a small university in his home state, and completed a degree in music education. After graduation, Mr. B moved to Texas and took a teaching position as the band director in a rural town. Mr. B. said of that year, "I found out very quickly I *hate* teaching music." He finished that year, completed the Texas certification requirements for secondary mathematics, and has been teaching mathematics and statistics in School District B ever since.

Although Mr. B lives in a region with multiple opportunities for graduate work, prior to his ITS Center experience, Mr. B did not have graduate hours at any university. During the Texas "Career Ladder years" (1984-1993) Mr. B did not have the required professional development or graduate credit hours to achieve level two. However, he regularly attended the state-wide Conference for the Advancement of Mathematics Teaching (CAMT) and Advanced Placement (AP) conferences, and has attended several annual meetings of the National Council for the Teaching of Mathematics (NCTM) with his wife who for many years was also a mathematics teacher in School District B. Mrs.

B, who is now a counselor at the School District B alternative campus, taught middle school and high school mathematics, seven years in a classroom across the hall from Mr. B. It was at one of these AP conferences that Mr. B. learned about the ITS Center.

Mr. B was looking to expand his knowledge of statistics beyond the content he was teaching in the AP statistics course. He asked the professor in charge of statistics at the conference for suggestions. At the time, Mr. B did not feel prepared for a full graduate program in statistics, but he wanted to expand and deepen his understanding. The professor suggested that Mr. B look into the program offered through the ITS Center. When Mr. B looked into the program on the ITS Center website, he thought, "I don't know what it is, but it sounds very interesting." So he applied and was accepted into the second cohort of the ITS Center.

*Mr. B's ITS experience.* As a mathematics teacher in a "science" center, Mr. B's experience during the summer was different from that of the science teachers. Mr. B was on an applied science team. There was another mathematics teacher on this science team. During the ITS Center summers, Mr. B was teaching only AP Statistics. The other mathematics teacher taught both Precalculus and AP Statistics. Mr. B reported that they worked together to develop their Instructional Frameworks. They found applications from their science team for Precalculus, but they had

> a tough time with the AP statistics figuring out exactly what we could do. There were some places where there were logical connections to sort of an elementary statistics. Unfortunately those connections tended to be with some aspects of

> elementary statistics that just are not part of the AP curriculum, so to bring that in would have had to add to a curriculum that is already rather full.

Both teachers worked closely with the lead scientist on the team, but during the first summer, Mr. B developed an Instructional Framework that he was unable to implement. However, during the second summer, Mr. B created a new Instructional Framework that he was able to implement in his curriculum and to examine its impact.

*Mr. B's current leadership*. In 2003, the same year Mr. B began his ITS Center experience, the position of mathematics department chairmanship became available at B High School. Mr. B and another teacher both volunteered for the position. Since the principal "could not make up his mind," according to Mr. B, both Mr. B and the other teacher were appointed as co-chairs. This lasted during the two years of Mr. B's ITS participation. Mr. B feels that this shared leadership worked well because they were "polar opposites" and "played well off of each other's strengths." At the end of the two years, the other teacher became the Dean of Student Instruction, and Mr. B continued as the sole department chair.

Mr. B works with the mathematics chairs from the other two School District B high schools to plan and provide professional development for secondary mathematics teachers. One effort they have undertaken is writing across the curriculum to engage students in writing to deepen mathematics understanding. They have also provided professional development on applying the 5E approach, (Engage, Explore, Explain, Elaborate, and Evaluate) proposed by Trowbridge and Bybee (1990) for science instruction, to secondary mathematics.

Mr. B also leads by example. Since beginning his ITS Center experience, Mr. B has decreased the amount of class time he spends lecturing and increased the amount of class time on inquiry. He says of himself, "Yes, and I have a long ways to go. I still have not totally let go of wanting to lecture. But I'm now aware of what I need to do, and so it is gradually becoming easier to find and develop alternatives." He rearranges the desks in his classroom depending on the nature of the lesson each period. Rarely are his desks arranged in rows. Mr. B uses calculators in his classes daily, but his use of computers is limited by access. B High School has three portable laptop carts (computers on wheels or COWs) and two general purpose computer labs for approximately 100 teachers. Use of the labs or COWs is on a first come, first served basis. Planning long range for computer use can be difficult.

Classrooms at B High School are assigned by content area. Most of the mathematics classrooms are along a single, second floor hall in the 1950s portion of the building. However three mathematic teachers have classrooms in the 1990s addition to the building. The teachers along the "math hall" are collegial—sharing materials, ideas, and expertise. During the observations for this study, students from another mathematics teacher's class ran into a calculator-related difficulty their teacher could not solve. The teacher sent two of his students to Mr. B's room for technical assistance, which Mr. B freely offered. Only in one of the ten or so mathematics classrooms were the desks arranged in rows; that class was taking a test. All of the other classrooms had the desks in groups with students working cooperatively. However, all three of the mathematics classes in the other part of the building had desks in rows with the teacher

up front delivering a traditional lecture. Mr. B reported that it was harder to get these isolated teachers engaged in the activities and discussions common to the "math hall" teachers.

*Impact of ITS Center experience.* Prior to the ITS Center experience, Mr. B was "pretty much just sort of doing my own thing in here, not paying a lot of attention to what was going on in the department." He was working with others a little bit, but as the only AP Statistics teacher, he felt "sort of isolated" other than limited vertical alignment work with the other pre-PA math teachers and the AP Calculus teacher. Mr. B did not think of himself as being in any kind of leadership role. He said, "I don't think I was even consciously having that thought. It was not deciding not to be in a leadership role; it just hadn't occurred to me."

Since his ITS Center experience, Mr. B has grown in leadership roles both on his campus and throughout the district. On his campus, a few fellow teachers are aware of Mr. B's experience, as is his principal. Mr. B stated that since his principal does not have a science or mathematics background, his understanding of the nature of the ITS Center experience was limited. However, the principal was aware that Mr. B was very enthusiastic about what he learned. District-wide, Mr. B thinks there is little notice or recognition of his participation. The greatest impact, according to Mr. B, was in his own level of security about his knowledge and leadership.

*Role of ITS Center experience.* An important factor of Mr. B's ITS Center experience was his introduction to educational research. Mr. B said that the key component in his ITS Center experiences was

> opening my eyes to the idea of using research and evidence to support change. That was probably not as new to some others who were already in graduate school. But for someone who had been in the classroom for 20 years and hadn't been to graduate school, that was quite an eye opener to me.

Mr. B said that in the past, he would bring ideas to his fellow teachers and say, "Hey, I got this idea." Now as a result of his increased awareness of educational research and data-driven decision making, he is able to say, "Here's research evidence to support that this is good, that this will work when implemented correctly, and let's pursue this."

Mr. B referred to the importance of the relationships developed during the ITS Center summers. The professor leading Mr. B's science team was especially influential. Mr. B said that this professor was fascinated with the process of learning. Mr. B said,

> We as a group had some lengthy conversations about teaching, and he [the professor] was quite intrigued and shared his experiences of his first what he describes as a disastrous attempt at teaching and his self-recognition that he had to do something about this. So I think that just because of who he is, he was quite instrumental in keeping us together and kind of getting us to reflect on why we were there and what we could do.

Mr. B has stayed in contact with this professor and exchanges ideas by email with him.

Mr. B felt that informal interaction among participants was also an important part of the ITS Center experience. During the ITS Center experience, the science professor acquired keys to the building and the computer lab for all of the Cohort II participants.

Mr. B reports that they would “hang out in the lab in the evenings, working on various things,” especially during the second summer.

*Summary*

Both Ms. A and Mr. B credited the relationships that they developed through their ITS Center experience as being the primary factor that impacted their leadership. Ms. A viewed her relationships with more experienced teacher participants and the ITS Center graduate students as being the most influential. Mr. B felt that his relationships with faculty members, both on his science team and the education faculty, supported his leadership development. A second factor of the ITS Center experience identified by both Ms. A and Mr. B that contributed to leadership development was the two-year cycle with the built-in accountability for implementation. Another factor of the ITS Center experience that was identified by both Ms. A and Mr. B was the Practitioner Research Plan that participants developed during the second summer (2004) and implemented during the following school year. This experience gave both teachers a better understanding of educational research and the importance of using data to make program and curriculum decisions.

# CHAPTER V

# DISCUSSION AND CONCLUSIONS

This chapter summarizes the findings of the present study and discusses implications and recommendations for future research. The purpose of this study was to explore the changes in teachers' descriptions of their leadership in their school settings before and after their participation in a science education leadership program and the aspects of their science education leadership experience that selected teachers identify as contributing to their change in leadership. In this chapter, the results of the analyses employed to examine teacher-participants' roles, activities, and the factors of the ITS Center participation that impacted teacher leadership are discussed and related to previous research. Next, implications of the findings to practice are discussed. Finally, recommendations for future research are presented.

## Summary of Research Findings and Relationship to Existing Research

This section reviews each of the research questions, summarizes the relevant findings related to each question and relates the findings to existing research. As noted in Chapter II, one of the problems encountered in efforts to synthesize teacher leadership research is the lack of a consensus definition of "teacher leader" to serve as a base prescriptive for empirical studies (York-Barr & Duke, 2004). Another problem York-Barr and Duke identified was that each study used a different instrument to measure teacher leadership. With this in mind, the present study used existing instruments in order to facilitate knowledge generation**.**

*Question 1*

How do teachers describe their leadership roles and activities in their school settings before and after their participation in a science education leadership program?

In this study, demonstration of leadership was based on self-reports of leadership roles and activities before and after the teacher-participants' ITS Center experience. Data were collected through a Likert-type survey, the *Teacher Leadership Roles Survey* (Appendix A) administered as a part of the application for participation in the ITS Center in Spring 2003 and through an online follow-up survey sent to participants in Fall 2006.

The *Teacher Leadership Roles Survey* is a combination of two instruments developed by Smylie and Denny (1990): (a) Teacher Leaders' Definitions of Leadership Roles and (b) Activities of Teacher Leaders by Time Expended. This survey was selected based on the alignment of identified teacher-leader roles and activities with the literature on teacher leadership and the documentation provided by Smylie and Denny on the development of the survey. Smylie and Denny used a multistage interactive method of data collection, analysis, and interpretation to develop these surveys. They first conducted open-ended interviews with teacher leaders asking them how they defined their roles as leaders, what leadership activities they engaged in, and what factors influenced their leadership. These data were analyzed using a comparative method (Glasser & Strauss, 1967) to identify themes and patterns. The themes and patterns were then discussed with district-level school personnel not directly involved with the teacher leadership program. After this discussion, themes and patterns were

codified and developed into Likert-type surveys that were administered to each of the teacher leaders.

*Roles.* Teachers were asked to rate the extent to which eight leadership roles matched their current role at school from 1 (*Not at all*) to 5 (*To a very great extent*). These leadership roles were: (1) Facilitator/enabler, (2) Helper for teachers, (3) Catalyst for individual teacher improvement, (4) Generator of new ideas for teachers, (5) Source of emotional support for teachers, (6) Source of knowledge for teachers, (7) Administrator of programs and policies, and (8) Evaluator of other teachers.

The teacher participants in this study rated (6) Source of knowledge for teachers as their top role as a group after the ITS Center experience followed by (4) Generator of new ideas for teachers, which were both increases from the Spring 2003 survey. Each of these roles align with the ITS Center focus to increase teachers' science content knowledge and pedagogical content knowledge. The ITS Center was also designed to increase teachers' knowledge and skills related to the use of information technology used in science research. This result also matches the roles of leading though knowledge and idea generation. The lowest scoring roles were (7) Administrator of programs and policies and (8) Evaluator of other teachers. These roles are traditionally seen as belonging to campus administrators rather than teachers and were not addressed in the ITS Center experience.

The original Smylie and Denny (1990) survey was given after the selected teachers completed professional development in teacher leadership. Unlike the ITS Center experience, which was targeted to science education leadership for teachers, the

program in the Smylie and Denny study was structured for more general leadership development. Table 5.1 compares survey results from the Smylie and Denny study and the post ITS Center experience of teachers in the present study reported in Chapter IV. Both the ITS Center teachers and the Smylie and Denny teachers rated the traditional administrator roles as the lowest. Where the results differ are in the top roles. The highest ITS Center teacher role (6) Source of knowledge for teachers was just slightly above administrator and evaluator for the Smylie and Denny teachers. The top Smylie and Denny role (1) Facilitator/enabler rated fifth for the ITS teachers.

**Table 5.1**
**Study Participants Compared to Smylie & Denny Results Leadership Roles**

| | ITS Fall 2006 | | Smylie & Denny | |
|---|---|---|---|---|
| Leadership Roles | Mean | SD | Mean | SD |
| 1. Facilitator/enabler | 4.11 | 1.17 | 4.33 | 0.78 |
| 2. Helper for teachers | 4.33 | 1.12 | 4.25 | 0.87 |
| 3. Catalyst for individual teacher improvement | 4.44 | 0.88 | 4.25 | 0.97 |
| 4. Generator of new ideas for teachers | 4.67 | 0.50 | 4.08 | 1.08 |
| 5. Source of emotional support for teachers | 3.67 | 1.00 | 4.08 | 1.16 |
| 6. Source of knowledge for teachers | 4.78 | 0.44 | 3.92 | 1.08 |
| 7. Administrator of programs and policies | 3.00 | 0.70 | 2.33 | 1.15 |
| 8. Evaluator of other teachers | 3.00 | 1.12 | 1.67 | 0.98 |

*Activities.* Teachers were asked to rate the leadership activities they engaged in. The eight leadership activities are: (9) attend (participate in) program-related meetings; (10) engage in building-level decision making related to curricular, instructional and professional development planning; (11) develop district-level curricular programs; (12) develop curricular/instructional materials; (13) plan building-level staff development

activities; (14) develop building-level curricular/instructional programs; (15) meet with principal to discuss principal's concerns and plans for building; and (16) promote implementation of district-level programs. These activities are numbered 9-16 to avoid confusion with the eight roles discussed above. The response choices were the same as for roles: from 1 (*Not at all*) to 5 (*To a very great extent*).

The primary activity of the ITS Center teacher-participants was to develop curricular/instructional materials. This result matches with their identified primary role as a source of knowledge for teachers and with the ITS Center focus on development of Instructional Frameworks during the Summer Institutes. The second highest activity was to attend program-related meetings followed closely by engaging in building-level decision making. These two activities tend to be linked because many building-level decisions are made in program-related meetings or as a consequence of program-related meetings. These activities also align with the role of being a generator of new ideas for teachers since program-related meetings are a mechanism for sharing ideas. The activity that teacher-participants reported decreasing the most was (16) *Participate in formal inquiry*. A probable reason for this decrease was an increased understanding of "formal inquiry" as a result of their ITS Center Practitioner Research Plan.

Smylie and Denny (1990) did not report mean and standard deviation from their sample. Although they used a five-point scale similar to the scale for roles, they reported only rankings for each activity. Thus, Table 5.2 compares the Fall 2006 rankings by activity of ITS Center teachers to the rankings given by the Smylie and Denny teachers. Activities that "tied" are given the same ranking. The Smylie and

Denny activity *Promote implementation of district-level programs* was accidently left off the ITS Center application but included in the post-ITS Center experience survey. Since the Smylie and Denny (1990) data are post-experience only comparisons to the ITS Center post-survey responses are reported here and labeled "17." Unlike the roles, ITS Center teacher-participants and the teachers in the Smylie and Denny study reported very similar activities. However, the ITS Center teachers-participants' activities matched their roles. Smylie and Denny reported that their teachers spent most of their time involved in activities that were at variance with their identified roles. The ITS teacher leaders viewed their leadership as bringing new understanding of science, information technology, and instructional technology; their activities reflected this view. The Smylie and Denny teacher leaders viewed their leadership as supporting and helping; activities for these teachers were more administrative than supportive.

**Table 5.2**
**Rankings of Leadership Activities from ITS Center Fall 2006 and Smylie and Denny (1990)**

| Activities | Fall 2006 | Smylie & Denny |
|---|---|---|
| 9. Attend program-related meetings | 2 | 1 |
| 10. Engage in building-level decision making | 3 | 2 |
| 11. Develop district-level curricular programs | 4 | 2 |
| 12. Develop curricular/instructional materials | 1 | 2 |
| 13. Plan building-level staff development activities | 7 | 5 |
| 14. Develop building-level curricular/instructional programs | 5 | 6 |
| 15. Meet with principal to discuss principal's concerns for plans for building | 6 | 7 |
| 17. Promote implementation of district-level programs | 4 | 8 |

When Smylie and Denny interviewed the other teachers on their teacher leaders' campuses, they uniformly expected the teacher leaders to provide content knowledge and pedagogy support. However, they felt that their teacher leaders did neither of these. The Smylie and Denny teacher leaders also felt a tension with the formal leadership title; they wanted the leadership role and responsibility without being seen as "different" from their fellow teachers. In contrast, interviews with Ms. A, Mr. B, their fellow teachers, and their administrators did not demonstrate this tension. Ms. A and Mr. B were both comfortable with their leadership titles. Their fellow teachers viewed them as providing content knowledge and pedagogical content knowledge. Everyone viewed Ms. A and Mr. B as teachers and colleagues in a leadership role.

*Change in leadership roles and activities.* The teacher-participants varied greatly in their amount of change in scores from Spring 2003 to Fall 2006 as shown in Table 5.2. As discussed in Chapter II, research indicates that the ability of teachers to demonstrate leadership depends on intrinsic and extrinsic factors. Intrinsic factors include the teacher's teaching experience and skills (Fullan, 1994; Katzenmeyer & Moller, 1996; Lieberman et al., 1988; Ryan, 1999; Sherrill, 1999; Suranna & Moss, 2000) and the teacher's leadership skills (Crowther et al., 2002; Sherrill, 1999; Yarger & Lee, 1994). Extrinsic factors are the environment for teacher leadership on the teacher's campus and in the district. In order to support teacher leadership, the literature identifies the need for changing the traditional school culture and climate from top down decision-making and teacher isolationism to one that supports collaborative leadership (Stone et al., 1997). Ash and Persall (2000) concluded that sustained teacher leadership will only

be successful if fundamental changes in the roles of teachers and administrators occur. A culture must be created in which the principal is not viewed as the controlling authority, but rather supports teachers and creates opportunities for them to develop and grow (Harris & Drake, 1997). However, this climate is fragile; change in a campus principal can have direct impact on a teacher's leadership roles and activities (Ash & Persall, 2000; Childs-Bowen et al., 2000). If the teacher leader changes from one campus or district to another, the leadership role and activities are subject to great change. This was true of the three teachers demonstrating the greatest decrease in leadership roles and activities. One changed campuses within a district, and the other two changed districts entirely.

*Question 2*

Of the teachers greatly increasing leadership roles and activities, to what extent do teachers attribute changes in their leadership to their ITS Center experience?

In the present study, this question was answered through identifying two teacher-participants who had greatly increased their leadership roles and activities following their ITS Center experience. Change by teacher for leadership roles, leadership activities, and survey total was calculated (shown on Table 5.2). Mr. B (PKID 39) and Ms. A (PKID 106) were selected since they exhibited the greatest positive change and met the criteria of school size, diversity of school setting, and demographic diversity as outlined in Chapter III. Additionally, they had greatly differing backgrounds.

Both Ms. A and Mr. B credited the relationships that they developed through their ITS Center experience as being the primary factor that impacted their leadership.

Ms. A viewed her relationships with more experienced teacher participants and the ITS Center graduate students as being the most influential. Mr. B felt that his relationships with faculty members, both on his science team and the education faculty, supported his leadership development. A possible reason for this difference is their differing backgrounds. At the time of her ITS Center experience, Ms. A was in her twenties and had taught for three years. Mr. B was in his forties and had taught for 20 years.

Two different theoretical frameworks provide possible explanations for this difference. One framework is near-peer mentoring common in medical education and expanded more broadly to higher education and adult education (Desai et al., 2008; Lockspeiser et al., 2008; Zemke & Elger, 2005). In this model, a near-peer mentor is someone with similar background who has recently completed the stage of learning of the person being mentored (mentee). The mentor and the mentee share a similar knowledge base, or a ‘‘cognitive congruence,’’ which allows the mentors to use language that their mentees understand and to explain concepts at an appropriate level (Lockspeiser et al., 2008, p. 362).

Another theoretical framework is Vygotsky’s zone of proximal development that describes “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under guidance or in collaboration with more capable peers” (Vygotsky, 1978, p. 78). In this case, the fellow teachers and graduate students were Ms. A’s more capable peers while the faculty members were Mr. B’s more capable peers.

A second factor of the ITS Center experience identified by both Ms. A and Mr. B that contributed to leadership development was the two-year cycle with the built-in accountability for implementation. Ms. A implemented her Instructional Framework and built on that experience in developing her Practitioner Research Plan. Mr. B was unable to implement his Instructional Framework, but he felt that his analysis of why it was not implemented added to his understanding of educational research and strengthened his Practitioner Research Plan. This result aligns with current theory and research on effective professional development. This literature indicates that the *format* of the professional development is not as important as the active engagement of the teachers, the duration of the experience, and accountability for implementation (Caine & Caine, 2000; Garet, Porter, Desimone, Birman, & Yoon, 2001; Loucks-Horsley et al., 2003).

Another factor of the ITS Center experience that was identified by both Ms. A and Mr. B was the Practitioner Research Plan that participants developed during the second summer (2004) and implemented during the following the school year. This experience gave both teachers a better understanding of educational research and the importance of using data to make program and curriculum decisions. They each reported the importance of using evidence in the context of their current leadership roles and activities. They each believed that developing the Instructional Framework during the first summer was valuable, but it did not impact their leadership as much as the Practitioner Research Plan did. They also cited faculty and graduate student modeling of

developing a research plan as an important component of being able to develop and implement their own plans.

While not a factor of ITS Center participation, but possibly important to Ms. A's and Mr. B's leadership roles, data gathered for triangulation and presented as background in Chapter IV indicated that both schools were experiencing change and were open to expanded leadership to increase student achievement. The state testing had just changed from the Texas Assessment of Academic Skills to the Texas Assessment of Knowledge and Skills. The eighth-grade science test was being re-instated. Middle School A was experiencing rapid growth and had just changed from a block schedule of four classes a day on alternating days to a seven-period class day. B High School was experimenting with different schedules to increase student success in Algebra I while beginning to offer the International Baccalaureate program as well as the Advanced Placement program. In both situations, the schools were more open to an expanded role for teacher leaders if the result was greater student achievement.

Just as this study used the Smylie and Denny (1990) survey to answer Question 1, Question 2 was answered using a modified Microcosmos interview protocol (Martinez, 2000). The Microcosmos project was a National Science Foundation funded professional development and teacher leadership Teacher Enhancement project (DLR 9153826; $1,129,126; 1992-1996). Microcosmos brought teachers in for a two-week science content experience during the summer. The following summer, a subset of those teachers was brought in for a one-week leadership development experience. The Martinez study followed up with 15 of the teachers who participated in both the science

and the leadership experiences. Martinez found that six attributes of the Microcosmos project contributed to the development of teacher leadership: (1) use selection criteria that measures desired attitudes and behaviors; (2) offer content that participants see as having educational merit; (3) provide experiences that meet participants' perceived need; (4) model strategies of implementation expected by the project; (5) instill commitment to the program; and (6) prepare and support participants' implementation.

Unlike the ITS Center, the Microcosmos project provided professional development on specific science curricula that could be directly implemented in the classroom. However, several of the Martinez findings relate to the present study. First, the ITS Center used the Leadership Survey as a component of the application process. This indicated to teachers from the beginning that leadership development was an expected outcome of the ITS Center experience. This matches the first Martinez attribute of selecting teachers based on desired attributes and behaviors (roles and activities). For the Martinez-defined attribute to provide experiences that meet perceived need, one of the common statements related to the relationships the Microcosmos teachers developed with other teacher leaders as a result of the leadership development experience. This Martinez finding parallels the impact of relationships with fellow teachers (Ms. A) and faculty members (Mr. B) in the ITS Center.

*Summary*

The teachers in this study demonstrate leadership through serving as a source of knowledge for teachers and generating new ideas for teachers. Their primary leadership activities are developing curricular/instructional materials and attending program related

meetings. Of the 15 teacher-participants in this study, seven increased their leadership roles and activities, six decreased, and two remained the same. All of the teachers who increased their scores on the Leadership Roles Survey had formal "first-wave" (Silva et al., 2000) leadership titles such as department chair. However, rather than being responsible solely for ordering supplies and keeping records, their roles and activities more closely aligned with the second-wave description of serving as instructional leaders and curriculum developers.

The two teacher-participants whose scores increased the most, Ms. A and Mr. B, were seen as team leaders rather than in any supervisory capacity as reported by their fellow teachers. Also in a second-wave teacher leadership role, both Ms. A and Mr. B provided professional development for teachers in their buildings and throughout their district. Additionally, Ms. A's and Mr. B's leadership roles were a part of their day-to-day classroom teacher roles. They mentored, solved problems, and provided professional growth opportunities for teachers on their campuses (Wasley, 1991).

Ms. A and Mr. B both credited their participation in the ITS Center experience as contributing to their development as leaders. Ms. A noted that her ITS Center certificate played a role in her getting her leadership position. Mr. B felt, and his administrator confirmed, that while his ITS Center participation did not directly influence his selection as chair of the mathematics department, it did enhance his ability to serve as a leader and mentor. Factors of the ITS Center participation that contributed to their leadership development were the mentoring and relationships with fellow teachers, graduate students, and faculty members; the extended, sustained interaction with the ITS Center

and accountability for implementation; and developing and implementing the Practitioner Research Plan.

## Implications for Practice

The stated purpose of this study was to investigate the leadership roles and activities of ITS Center teacher-participants and factors of ITS Center participation that affected their roles in order to identify the connection between teacher-participants' roles and activities and the factors of ITS Center participation that impacted the teacher-participants' leadership. The desired outcome was to provide evidence of practices that could be used in teacher leadership professional development programs to increase teachers' content and pedagogical leadership that could, in turn, increase student academic achievement.

This study comes at an opportune time. Funding for teacher leadership development programs is increasing. The 2009 American Recovery and Reinvestment Act (Stimulus Bill) signed February 19, 2009 included an additional $25 million dollars to expand the National Science Foundation Math and Science Partnerships (MSP) and $60 million dollars to expand the Robert Noyce (Teacher) Scholarship program (Office of the Vice President for Research, 2009) in addition to the money designated in the annual National Science Foundation budget ($35 million for MSP and $14 million for Noyce). Other teacher leadership programs through the U.S. Department of Education and various state education agencies are ongoing.

Based on existing theoretical frameworks and results from the present study, the following recommendations for practice are made:

1. Design opportunities to develop mentoring relationships. Mentoring among teacher participants and mentoring by university faculty members and graduate students were each cited as important. Mentoring occurred during formal ITS Center summer activities, outside of the formal activities during the summer, and during the academic year. Formal mentoring was planned with the ITS Center graduate students serving as Campus Resource Persons. However, mentoring relationships also developed among the participants and between ITS Center faculty and teacher participants.

2. Plan for sustained engagement. The ITS Center participation spanned two years and included more than 100 contact hours each summer for two consecutive summers. Academic year engagement beyond the 100+ summer hours was also included.

3. Plan for accountability in implementation. ITS Center participants were held accountable for implementing the Instructional Framework and Practitioner Research Plan through stipends structured to be earned in stages. The bulk of the stipend was provided for participating in the summer courses. However, additional stipend was earned upon completion of implementation reports. Furthermore, participation in the second summer depended on completion of the implementation report about the Instructional Framework.

4. Relate required implementation to current research in a manner that teachers can apply in their own settings. The development and implementation of the Practitioner Research Plan exposed the ITS Center teacher-participants to current education research

and helped develop their skills in conducting their own classroom inquiry. It also helped them understand about using data to make curricular decisions.

5. Provide official recognition for teacher leadership professional development. While one of the teachers in the case study portion of the present study did not indicate that the ITS Center Teacher Leadership Certificate made a difference in leadership recognition, the other teacher cited this certificate as playing an important role in her school's recognition of her leadership. Both teachers stated that receiving credit for professional development hours was an important part of their participation.

6. Leadership development should focus on a content area or discipline, rather than generic leadership. Teachers in the Smylie and Denny (1990) study reported feeling separated and isolated from the colleagues because their leadership development program set them apart. The ITS Center teachers did not report this feeling. In fact, teachers in Ms. A's and Mr. B's schools appreciated the knowledge and experience Ms. A and Mr. B developed during their ITS Center experience and looked to them as colleagues that could contribute to the school.

7. A meaningful, sustained relationship between school districts and the leadership development program can sustain leadership roles in the schools. The Smylie and Denny (1990) program was built on a partnership between the school district and the leadership program, which influenced the selection of teachers to participate in the program and enhanced the recognition of teacher leaders in the school. The ITS Center did not have any partnership with teacher-participants' schools. While this partnership would have little impact on the leadership roles and activities of teachers who change

districts, it potentially could impact selection of participants and support for their leadership in the schools.

While none of the recommendations for practice in the present study are new, they do confirm guidelines developed primarily in theoretical frameworks.

## Recommendations for Future Research

The present study was limited in both scope and scale. A similar study on Cohort III is recommended now that enough time has elapsed to see longer-term impacts than was possible when this study began. Additionally, interviews with teacher-participants who demonstrated a significant decrease in teacher leadership roles and activities are recommended to determine possible reasons for this decrease. A longitudinal study of ITS Center teacher-participants would also be beneficial to examine the long-term impacts of participation on teacher leadership.

This study only examined the impact on participants who were classroom teachers when they applied for participation in Spring 2003 and were still in the classroom in Fall 2006. An important outcome of leadership development would be to look at the teachers who left the classroom for other education leadership positions. For example, one Cohort II teacher participant is now an assistant professor in teacher education at another university. Several have left the classroom to work full time on teacher professional development in school districts, education service centers, and other education-related agencies. These participants are all serving in science education leadership roles. Studies of the impact of their ITS Center experience would contribute to the literature.

The teachers participating in the ITS Center were self-selected. In Cohort I, nearly everyone who applied was selected. In Cohort II, only those applicants from grade levels and content areas not addressed in the program were not selected. As discussed above, several of the teacher-participants were already demonstrating considerable leadership roles and activities. A similar program could select teachers based on their *potential* for leadership. By selecting teachers with potential rather than teachers already in leadership, change in leadership roles and activities might be more informative.

As York-Barr and Duke (2004) found in their review of teacher leadership research, synthesis of teacher leadership research is complicated by the wide variety of definitions of teacher leadership and methodologies used to measure it. With this in mind, the present study examined teacher leadership roles and activities based on the work of Smylie and Denny (1990) and used an interview protocol modified from a protocol developed for a similar National Science Foundation-funded teacher leadership in science project. It would enable better meta-analysis and theory development about teacher leadership if future studies of teacher leadership used existing instruments and protocols.

Finally, the ITS Center did not have a partnership arrangement with any school campuses or districts. This was not required by the National Science Foundation when the ITS Center was funded in 2000. Applications were open to participants from across the nation, and no school administration support was required. By 2004, the National Science Foundation Centers for Learning and Teaching Program required commitments

from partner school districts to recruit teachers and to support them in specified leadership roles. Further research is needed to determine the difference between teacher leadership roles and activities with and without school-level commitments to the program. Research comparing the two, partnered and un-partnered, could also provide evidence for necessary components of a leadership development experience in the two situations.

## Conclusions

This study investigated the leadership roles and activities of ITS Center teacher-participants and aspects of ITS Center participation that affected their leadership roles. The purpose of the ITS Center was to develop science (and mathematics) education leaders through a program of study focused on the interaction between scientists, education researchers, and education practitioners.

Participants in this study were 15 classroom teachers who participated in Cohort II of the ITS Center. Their primary leadership roles were to serve as a source of knowledge and a generator of new ideas for their fellow teachers. Their major activity, which was directly related to these roles, was to develop curricular/instructional materials.

The change in leadership roles and activities was highly variable. However as the literature indicates, demonstration of teacher leadership is very dependent on context. The participants who greatly increased their leadership roles and activities moved into new, formal leadership roles following their ITS Center experience. Ms A and Mr. B, in particular, were at the point in their respective careers where they wanted to move into

leadership roles. However, the ITS Center application did not include any measures of potential for leadership, and *current* leadership roles and activities rather than *potential* were considered for ITS Center participation. Participants who greatly decreased their leadership roles and activities had changed school campuses or districts. Among the teachers demonstrating a large increase in leadership, components of the ITS Center experience described as contributing to increased leadership roles and activities were relationships developed with fellow teachers, graduate students, and university faculty; extended time of engagement in the ITS Center activities; accountability for implementation of their ITS Center Instructional Frameworks and Practitioner Research Plans; and their increased understanding of educational research and the role it plays in evidence-based decision making.

Participants in this study were limited to 15 teachers who chose (self-selected) to apply to Cohort II of the ITS Center, and only 2 of those were interviewed to investigate attributions of change. It would therefore not be appropriate to generalize these findings. However, it is hoped that findings from this study can inform the planning and execution of similar science and mathematics leadership programs. Educators implementing similar programs may reference the findings for further use.

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# APPENDIX A

# TEACHER LEADERSHIP ROLES

Teacher Leadership Roles

**Indicate the extent to which these leadership functions match your current role at school:**

| | Not at all | Rarely | Sometimes | Somewhat often | To a very great extent |
|---|---|---|---|---|---|
| 1. Facilitator/ enabler | 1 | 2 | 3 | 4 | 5 |
| 2. Helper for teachers | 1 | 2 | 3 | 4 | 5 |
| 3. Catalyst for individual teacher improvement | 1 | 2 | 3 | 4 | 5 |
| 4. Generator of new ideas for teachers | 1 | 2 | 3 | 4 | 5 |
| 5. Source of emotional support for teachers | 1 | 2 | 3 | 4 | 5 |
| 6. Source of knowledge for teachers | 1 | 2 | 3 | 4 | 5 |
| 7. Administrator of programs and policies | 1 | 2 | 3 | 4 | 5 |
| 8. Evaluator of other teachers | 1 | 2 | 3 | 4 | 5 |

**Indicate the extent to which these activities match your current leadership activities at school:**

| | Not at all | Rarely | Sometimes | Somewhat often | To a very great extent |
|---|---|---|---|---|---|
| 1. Attend program-related meetings | 1 | 2 | 3 | 4 | 5 |
| 2. Engage in building-level decision making | 1 | 2 | 3 | 4 | 5 |
| 3. Develop district-level curricular programs | 1 | 2 | 3 | 4 | 5 |
| 4. Develop curricular/instructional materials | 1 | 2 | 3 | 4 | 5 |
| 5. Plan building-level staff development activities | 1 | 2 | 3 | 4 | 5 |
| 6. Develop building-level curricular/ instructional materials | 1 | 2 | 3 | 4 | 5 |
| 7. Meet with principal to discuss principal's concerns and plans for building | 1 | 2 | 3 | 4 | 5 |
| 8. Promote implementation of district-level programs | 1 | 2 | 3 | 4 | 5 |
| 9. Participate in formal classroom inquiry | 1 | 2 | 3 | 4 | 5 |

# APPENDIX B

# MODIFIED MICROCOSMOS INTERVIEW PROTOCOL

## Modified Microcosmos Interview Protocol

### Session 1: Introduction and Questions 1 and 2

Introductory/background questions to set the stage:

1. Please tell me briefly why you entered teaching.
2. Please give me a general time line of your teaching career.
3. What made you want to participate in the NSF ITS Center?
4. Have you done any professional development activities since ITS? What was their nature?

### Question 1: What is teacher leadership?

Probes:

5. What does teacher leadership mean to you?
6. What do you believe are important behaviors for a teacher leader to have? Why?
7. Do you consider yourself to be a teacher leader? Why or why not?

### Question 2: What are you doing as a teacher leader?

Probes:

8. Prior to participating in the ITS Center program, in what types of teacher leadership have you participated? When and in what capacity? Were you appointed or did you volunteer? Was it in addition to classroom teaching or in place of it?
9. Since participating in the ITS Center program, in what types of teacher leadership have you participated? When and in what capacity? Were you appointed or did you volunteer? Was it in addition to classroom teaching or in place of it?
10. Have you presented any professional development workshops, either ITS Center-oriented or other? What was their nature?

11. If the opportunity should present itself, would you offer another professional development workshop to colleagues? Why or why not?

**Sessions 2 and 3: Questions 3 and 4**

**Question 3: How is what you are doing now as a teacher leader different than what you did before ITS Center participation?**

**Question 4: In what ways did ITS Center participation contribute to your teacher leadership?**

Probes:

12. Did you learn anything in the ITS Center program that you wanted to share with your colleagues? Why?
13. In what ways did the ITS Center program improve your science content knowledge?
14. What did you consider to be the key aspects of the ITS Center program to include in your own leadership activities?
15. Did the ITS Center enhance your image as a teacher leader within your school or district? In what ways?
16. Did you collaborate with any local colleges, universities, or other educational institutions when implementing your IF or PRP? If yes, in what ways has this been beneficial to you?
17. Which administrators or school staff were most helpful to you in getting your IF or PRP implemented? Has your relationship with them been affected as a result of the ITS Center?
18. In what ways has your perspective on science changed? Did this change impact your teacher leadership/mentoring of fellow teachers?

19. In what areas of your science curriculum so you now include technology? Has this been influenced by ITS Center program?
20. Have your science teaching strategies changed as a result of the ITS Center program?
21. What types of behaviors do you think you improved upon while participating in the ITS Center program? What part of the program helped you with this?
22. What specific activities were done during the ITS Center program that contributed to the success of your IF and PRP?
23. In what ways did implementing your own ITS Center IF and PRP help internalize or reinforce what you learned during the ITS Center program?

Final Wrap Up if not covered earlier

24. Do you believe you are a stronger teacher leader as a result of participating in the ITS Center program? Why?

# APPENDIX C

# ADMINISTRATOR PROTOCOL

Administrator Questions

Name_____

Position_____

1. How long have you known <Teacher Name>? In what capacity?

2. What does “teacher leadership” mean to you?

3. How does <Teacher Name> fit this description?

4. Are you familiar with <Teacher Name’s> participation in the Texas A&M ITS Center summer coursework and classroom research? If so, please tell me what you know about it and describe your role in <Teacher Name’s> implementation of <his/her> Instructional Framework and Practitioner Research Plan.

5. In your opinion, did <Teacher Name’s> participation have any impact on their leadership? If so, in what ways?

# APPENDIX D

Although the median response for (1) *Facilitator/enabler* decreased from 5 (to a great extent) to 4 (somewhat often), Figure D.1 illustrates a decrease in the variability of the responses from Spring 2003 to Fall 2006, with a single outlier for the post administration of the survey. The interquartile range also decreased on the survey administered after the ITS Center experience.

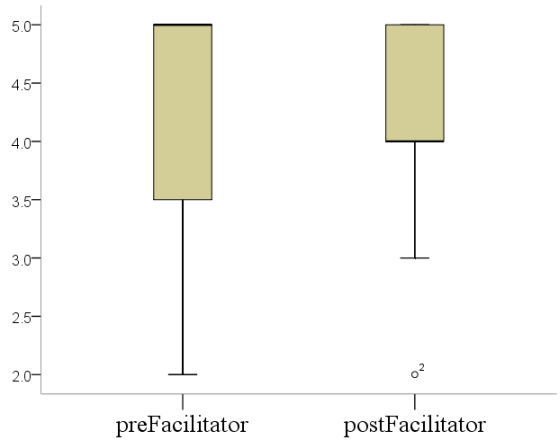


**Figure D. 1** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (1) Facilitator/enabler*

For the second role *Helper for teachers*, the median and interquartile range remained the same before and after the ITS Center experience, as illustrated in Figure D.2. Like the first role, the Fall 2006 survey had a single outlier responding Rarely. Interestingly, the outlier indicated by the circle labeled "2" in the Figures D.1 and D.2 are the same teacher. The ITS Center evaluation team assigned unique numbers, PKID numbers, to all participants. The teacher indicated by the circle labeled "2" was PKID 36.

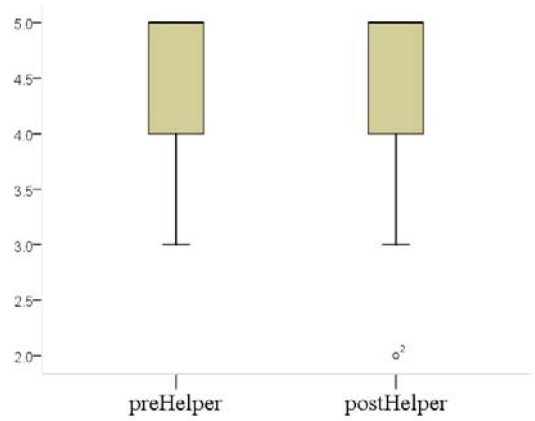


**Figure D.2** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (2) Helper for teachers*

Figure D.3 illustrates how box-and-whisker plots provide information that is hard to see in a table. In the Spring of 2003, two-thirds (a total of ten) of the teachers responded 4. Somewhat often" to role (3) *Catalyst for individual teacher improvement.* The two teachers who responded 3 (*Sometimes*) and three teachers answered 5 (*To a great extent)* were outliers. After the ITS Center experience, eight teachers responded 5 (*To a great extent*), only three responded 4 (*Somewhat often*), and four responded 3 (*Sometimes*).

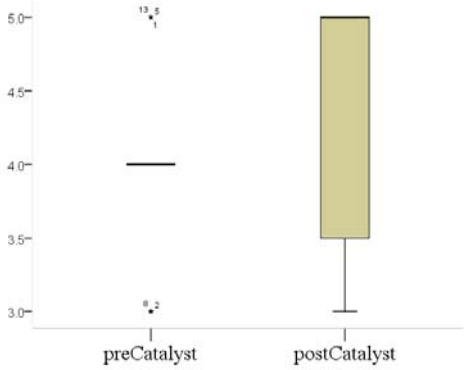


**Figure D.3** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (3) Catalyst for individual teacher improvement*

On role (4) *Generator of new ideas for teachers*, only the median changed, shown in Figure D.4 as the darker line at 4 on the left plot and the dark line at 5 on the right plot. The minimum, maximum, and interquartile range remained the same from the Spring 2003 and Fall 2006 administrations of the leadership survey.

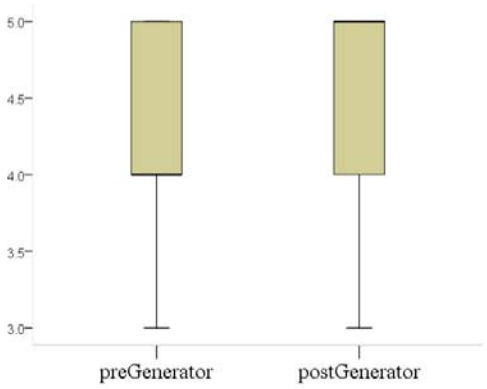


**Figure D.4** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (4) Generator of new ideas for teachers*

Unlike the first four roles described, the responses to role (5) *Source of emotional support for teachers* increased in variability from Spring 2003 to Fall 2006 as shown in Figure D.5. The median and the interquartile range remained the same, but the minimum decreased. No teachers gave this role a rating of 1 (*Not at all*) on the Spring 2003 survey, and one teacher rated this role as a 1 on the Fall 2006 survey.

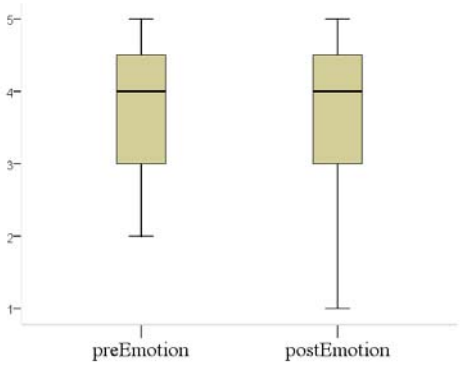


**Figure D.5** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (5) Source of emotional support for teachers*

More than any other role, (6) *Source of knowledge for teachers* (Figure D.6) decreased in variance from Spring 2003 to Fall 2006. All responses in Fall 2006 were either 4 (*Somewhat often*) or 5 (*To a great extent*). The median response increased from 4 to 5 also.

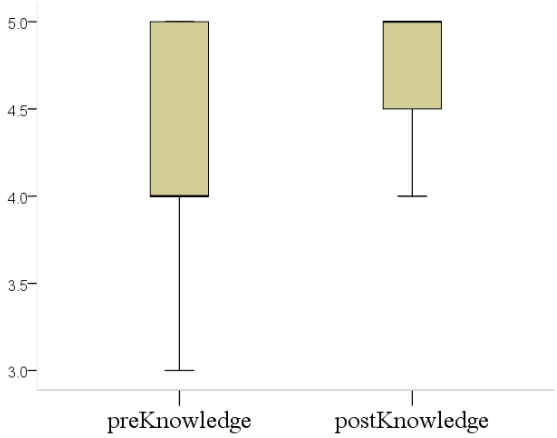


**Figure D.6** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (6) Source of knowledge for teachers*

The five-number summary and the box-and-whisker plots are nearly identical for the Spring 2003 and Fall 2006 role of (7) *Administrator of programs and policies*. The only difference seen in this representation is that the minimum changed from 2 (*Rarely*) in Spring 2003 to 1 (*Not at all*) in Fall 2006. This data point is shown as an outlier in Figure D.7. The outlier teacher for this role is PKID 110, different from the outlier teacher in roles 1 and 2.

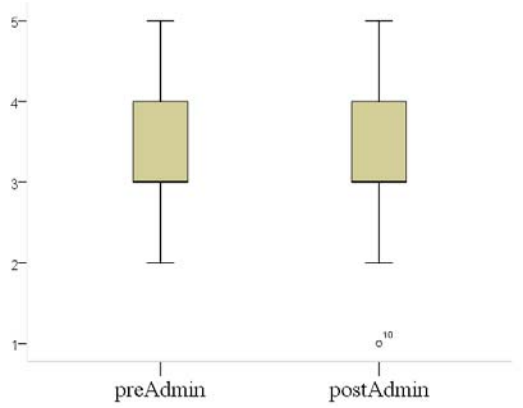


**Figure D.7** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (7) Administrator of programs and policies*

For the final role (8) *Evaluator of other teachers* (Figure D.8), the range from minimum to maximum increased from Spring 2003 to Fall 2006 while the median and interquartile range decreased. In the original administration of the survey, no one reported their role of evaluating other teachers as 5 (*To a great extent*). This changed on the post ITS Center survey even though the median response decreased from 3 (*Sometimes*) to 2 (*Rarely*).

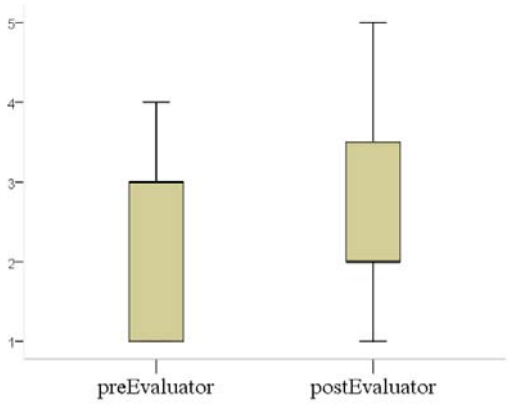


**Figure D 8** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (8) Evaluator of other teachers*

# APPENDIX E

Comparison of box-and-whisker plots for each activity further illuminates the changes in responses on activities between Spring 2003, before the ITS Center experience and Fall 2006, two years after the ITS Center experience. Figure E.1 illustrates that for (9) *Attend program-related meetings*, all but three of the respondents answered that 5 (*To a great extent*) described this activity as a part of their leadership. By Fall 2006, there was a greater spread among the responses. The median dropped from 5 to 4 (*Somewhat often*), and the interquartile range was from 3.5 to 5.

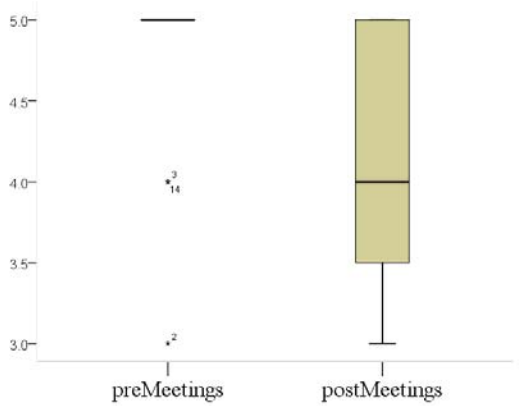


**Figure E.1** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (9) Attend program-related meetings*

Figure E.2 demonstrates that although the median remained the same for (10) *Engage in building-level decision making*, the spread was more balanced after the ITS Center experience than before, with the interquartile range equaling the minimum and maximum in Fall 2006.

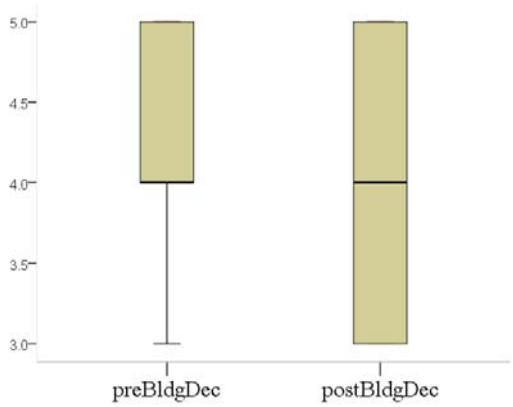


**Figure E.2** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (10) Engage in building-level decision making*

For (11) *Develop district-level curricular programs*, the box-and-whisker plots for Spring 2003 and Fall 2006 are identical as shown in Figure E.3. For (12) *Develop curricular/instructional materials*, the only difference shown in Figure E,4 is the single teacher outlier, PKID 155. This is a different teacher than the two who were outliers on the Roles plots (Appendix D).

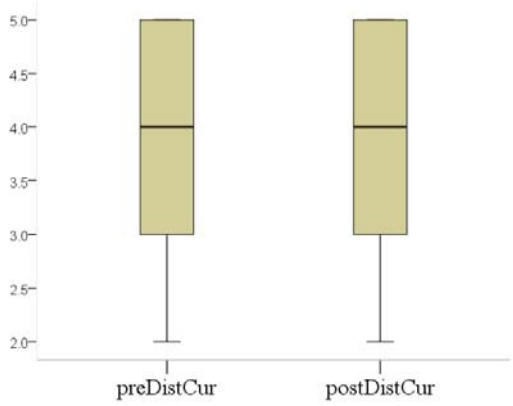


**Figure E.3** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (11) Develop district-level curricular programs*

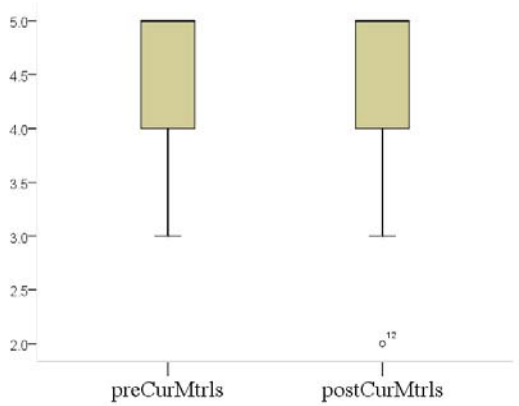


**Figure E.4** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (12) Develop curricular/instructional materials*

The median increased for (13) *Plan building-level staff development activities,* as did the interquartile range from Spring 2003 to Fall 2006 as shown in Figure E.5. The post ITS Center survey also had two outliers, PKIDs 155 and 179. PKID 155 is the same teacher who was the outlier for (12) *Develop curricular/instructional materials.*

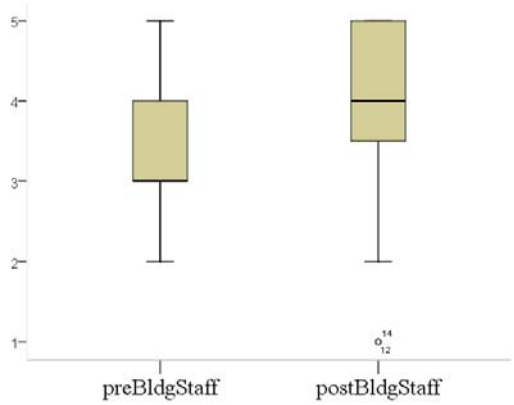


**Figure E.5** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (13) Plan building-level staff development activities*

Like the previous activity, Figure E.6 illustrates that the median increased between pre and post ITS Center experience. Additionally, teacher PKID 179 is an outlier. Minimum and maximum remained the same on both administrations.

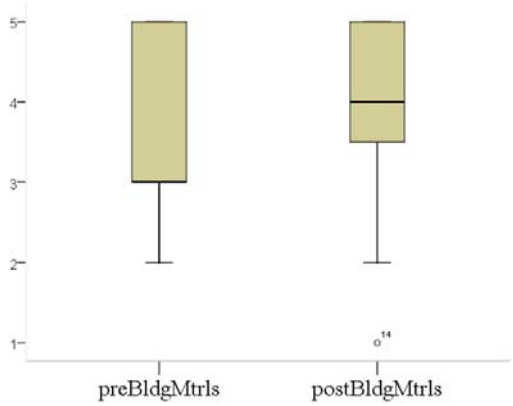


**Figure E.6** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (14) Develop building-level curricular/instructional programs*

Figure E.7 shows results for (15) *Meet with principal to discuss principal's concerns for plans for building*. Minimum, maximum, and interquartile range stayed the same while the median increased from 3 (*Sometimes*) to 4 (*Somewhat often*).

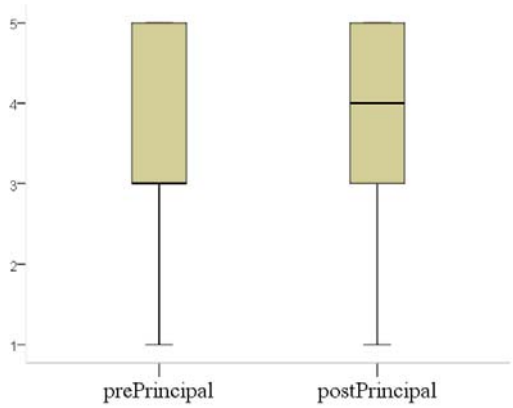


**Figure E.7** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (15) Meet with principal to discuss principal's concerns for plans for building*

For the final activity shown in Figure E.8, (16) *Participate in formal classroom inquiry*, the median dropped from 5 (*To a great extent*) to 4 (*Somewhat often*) from Spring

2003 to Fall 2006. In the initial administration, 12 of the 15 teachers answered 5 (*To a great extent*). After the ITS Center experience, the responses were more evenly distributed.

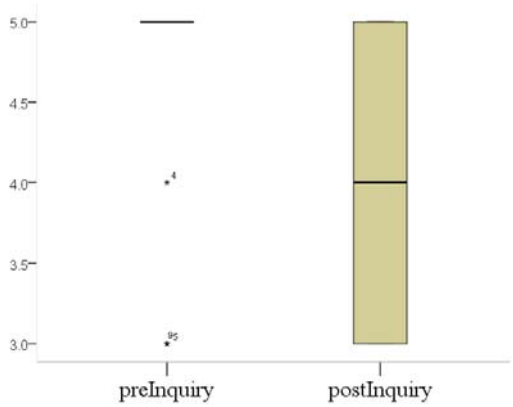


**Figure E.8** *Box-and-whisker plot for Spring 2003 (pre) and Fall 2006 (post) (16) Participate in formal classroom inquiry*

# VITA

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## PUBLICATION

Kimball, J., Cole, B., Hobson, M., Watson, K., & Stanley, C. (2008). A study of women engineering students and time to completion of first year required courses at Texas A&M University. *Journal of Women and Minorities in Science and Engineering 14*(2), 65-80.