Interventions/Outcomes Involving Teacher Leaders Supporting the Implementation of Instructional Materials


This article reports on the first 4 years of an effort to develop and implement a comprehensive and sustainable set of evidence-based curricula, professional development, and supportive whole school reforms aimed at raising mathematics achievement in high-poverty middle schools. Four related analyses examine the levels of implementation achieved and impact of the reforms on various measures of achievement in the first 3 schools to implement the Talent Development (TD) Middle School Model’s mathematics program that combines coherent research-based instructional materials from the University of Chicago School of Mathematics Project with a multi-tiered teacher support system of sustained professional development and in-class coaching. The first section of the article reviews the evidentiary basis for the enacted reforms, describes them, and provides information on the schools that participated in the study. The results of the study (the level of implementation achieved and the impact of the reforms on multiple measures of mathematics achievement) are detailed in the second section. The final section discusses the overall impact of the reforms and explores additional steps needed to achieve high levels of mathematical learning in high-poverty middle schools.

A moderate level of implementation was achieved. TD students outperformed students from control schools on multiple measures of achievement. The average effect size, $\Delta$, by the end of middle school was .24.

All of the middle schools in the study are large non-selective neighborhood schools that serve low-income minority populations in the School District of Philadelphia.

*Intervention:* A central feature of the TD Mathematics Program was the school-wide use of research-based instructional materials. In Grades 5 and 6, the schools implemented Everyday Mathematics, from the University of Chicago School Mathematics Project (UCSMP) elementary curriculum; in Grade 7, they used UCSMP *Transition Mathematics*; and in Grade 8, UCSMP *Algebra*. One of the three middle schools participating in the project was attempting to teach all students algebra in eighth grade, and one teacher at the school was already using the UCSMP series, so in this school the UCSMP *Algebra* text was adopted school-wide during the 1st year of implementation. The other two schools phased in the *Algebra* text over a 3-year period in order to allow time to build both student and teacher skills. In these two schools, both seventh and eighth graders used the UCSMP *Transition Mathematics* text during the 1st year of implementation. During the 2nd year, eighth graders completed units from the last half of the *Transition Mathematics* text and the first half of the *Algebra* text. In year 3, the *Algebra* text was used from the start of eighth grade. All three schools introduced
Everyday Mathematics Grades 5 (in the two 5-8 schools) and Grades 6 in the 1st year of implementation. Thus, by the start of year 3, all three schools were offering all students the same mathematics curriculum and sequence of courses, culminating with all students taking an algebra course using a challenging *Algebra* text in the eighth grade.

Teachers were offered multiple tiers of professional development linked to the implementation of the new mathematics curriculum. Three days of summer training were followed by monthly 3-hour workshops on Saturdays. Make-up sessions were offered during the week after school. In all, teachers had access to over 36 hours of professional development per year. Following the union contract attendance was voluntary, and teachers were paid the district rate for attending training outside the school day (approximately $20 per hour). Beginning in the 2nd year, arrangements were made with a local university to give teachers three graduate course credits if they completed 36 hours of training and related assignments. The goal was to provide teachers much more professional development than has been typically received by most mathematics teachers in the United States.

From the start, experienced peer teachers and users of the curricula led the professional development workshops. The sessions were grade specific and focused on the unit or lessons the teachers would be using during the following month. Those leading the sessions typically previewed and modeled key activities, reviewed core content knowledge and discussed appropriate classroom management strategies.

In addition to monthly professional development sessions, teachers had access to in-classroom implementation support from a curriculum coach. Each school was assigned a curriculum coach who spent 1 to 2 days per week in each school working with teachers in their classrooms. Implementation support was nonjudgmental and varied from classroom to classroom but included modeling, explaining, and co teaching, assisting with lesson planning, observing lessons and providing confidential feedback, and making sure that the teacher had all the materials needed to implement the lesson. The curriculum coach also worked with the teacher to make modifications to the curriculum based on the needs of the classroom. Overall, the coach’s job was to do what it took to provide teachers with the support they needed to achieve strong implementation in their classrooms.

During the 3rd year of the effort, an initiative was started to train two to three teacher leaders from each school to be on-site trainers and implementation support personnel, with the goal of making the schools self-sustaining over time. These teacher leaders received an additional 30 hours of training per year for 2 years and provided an additional layer of support in the schools. In each school, two teacher leaders were successfully recruited and completed the 2-year training sequence, which included both professional development sessions devoted to specific topics like assessment, student engagement, and mathematical discourse, as well as opportunities to shadow curriculum coaches as they worked with teachers, engaged in lesson study, and led professional development sessions.
Each summer, the teachers were invited to work in summer work groups to develop supplemental materials to help further customize and localize the instructional materials. During the first 2 summers, four two-teacher teams developed sets of teacher notes for each unit that provided instructional and organizational tips, pacing guides, and extra-practice problem sets and homework books. During the 3rd summer, September Introductory Units were developed. These units are designed to compensate for the “broken supply lines” found in many urban schools at the start of most school years.
The instructional improvement model with Data on Enacted Curriculum was tested with an experimental design using randomized place-based trials. The improvement model is based on using data on instructional practices and achievement to guide professional development and decisions to refocus on instruction. The model was tested in 50 U.S. middle schools in five large urban districts with half the schools in each district randomly assigned to receive the two-year treatment. Each school formed an improvement leadership team of five to seven members, including teachers, subject specialists and at least one administrator. Teams received professional development on data analysis and instructional leadership and then the teams provided training and technical to all math and science teachers in their school. The central premise of the treatment model is to provide teachers with data on their instructional practices and student achievement, to teach them how to use that data to identify weaknesses and gaps in instruction compared with state standards and to focus school-level professional development on needed curriculum content and classroom practices. After a two-year period of implementing the improvement model, the analysis of change in instruction showed significant effects of the model. The longitudinal analysis of instruction before and after treatment showed math teachers in treatment schools had significant improvement in alignment of instruction with standards compared with teachers in control schools, and the math teachers on the leader teams showed significantly greater gains than all other teachers.

The study design carried out from 2001 to 2004 consisted of place-based randomized trials, with middle schools in large urban districts randomly assigned to the treatment or control condition (Porter et al. 2005). The study team tested the hypothesis that the DEC model would significantly improve instruction in math and science at the middle grades level, with the dependent variable being the measured improvement in degree of alignment between instructional practices being taught and the state content standards for the grade level and subject (Blank et al. 2004).

Key Research Questions:

(1) To what extent does the DEC model for professional development improve the alignment of instruction in mathematics and science?
(2) What are the conditions for implementation of the model that explain positive effects?

DEC Model:
The DEC model is grounded with research-based tools (Surveys of Enacted Curriculum) that provide the capacity for describing instructional practices at the school level (both pedagogy and content) based on responses from all teachers of a given subject and grade, as well as tools for describing the content of the intended curriculum (e.g., expressed in content standards and assessments) through measures of the nature and degree of
alignment between instructional practices and curriculum materials. The treatment model can be understood in part by the nature of the data provided to school leadership teams and other teachers in the treatment schools.

All teachers in a target school report on their instructional subject content and teaching practices for the prior school year. The content of instruction is reported using a two-dimensional grid. Data reporting entails three steps.

1. The teacher works through the list of specific topics (e.g., for math: number sense, operations, measurement, algebraic concepts, geometric concepts, etc.), reporting on which of the topics were taught.

2. For the specific topics taught, the teacher describes degree of content coverage on a five-point scale for each specific subtopic (e.g., for numbers: place value, whole numbers, fractions, ratio, etc.), indicating whether the coverage represented (a) less than one class/lesson, (b) one to five classes/lessons, or (c) more than five classes/lessons.

3. For each subtopic covered, the teacher indicates which of the five categories of cognitive demand were taught (i.e., memorize, perform procedures, demonstrate understanding, prove, make connections), and for those that were taught, the degree of emphasis. The three-point emphasis scale distinguishes (a) slight emphasis (less than 25 percent of the time spend to the topic), (b) moderate emphasis (25-33 percent of the time spent on the topic), and (c) sustained emphasis (more than 33 percent of the time spent on the topic).

With the complete data report for each teacher’s course/class, a content map is constructed showing the proportion of emphasis ion topics by expectations/cognitive demand. State standards and assessments are content coded by expert subject specialist using the same SEC content matrix.

*Intervention for leadership teams:* The DEC treatment schools were asked to form a five-to seven-member mathematics and science school leader team at the outset of the project. The teams included at least one administrator—the principal or the assistant principal for curriculum—mathematics and science department chairs, lead or master mathematics and science teachers, and other math and science teachers such that a range of grades and subjects were represented. The teams participated in all project professional development workshops and meetings throughout the treatment.

The DEC trainer staff introduces to school leader teams the skills for leading collaborative work with a group of professionals, how to provide training on data analysis, and how to ask tough questions about which students are/are not learning, what content is being learned, and why some students are not learning. The leader team workshops model best practices in data analysis and in teaching specific subject-area topics, and provide support and strategies for how to engage colleagues.

*Intervention for all educators:* Professional development for all educators with the DEC model begins with training in data skills, including how to analyze and apply the enacted curriculum data charts and how to interpret differences in the contour maps and bar
graphs signifying high and low emphases of instruction across a school or district. The school team gains skills in the collaborative analysis method starting with one data chart (e.g., one subject topic area). Educators analyze their own school instructional data building from their experience of completing the survey, their knowledge of instruction in the school, and their team interaction about data variation they observe and discussion about sources of differences in instruction.

DEC leader teams work with teachers by subject area through a three-step process—predict, observe/analyze, and interpret. Teachers are asked first to predict what they will see in the degree of consistency or alignment, between math instruction and district and state standards (e.g., Florida middle math standards). In step two, educators look at the charts for math instruction and standards for their district and state. Educators work together in teams to share what they see—which topics and expectations have high emphases of time and how consistent they are with the standards.

The basic findings outlined from the three-year longitudinal study provide support for the premise that the DEC model for instructional improvement can have positive effects in many schools and districts.
What appears to be prolonged neglect of the department chair role in professional development is mirrored in formal research. “Departments are emerging as one fundamental part of the organization of schools which researchers have disregarded” (Johnson, 1990). Despite the momentum of restructuring efforts, the research on discipline area departments in the American high school is still scant with very little attention given to the role of department chairs (Siskin, 1994). The prominent descriptions we do have of departments were developed for another purpose, such as describing good teachers or exemplary high schools, as in The Best Teacher in America (Matthews, 1988) and The Good High School (Lightfoot, 1985).

While the role of the department chair remains largely unattended, this role is unique in its official inclusion of both teaching and administrative responsibilities. The potential of this position is largely untapped and, in the context of systemic reform, unknown, thus creating a definite gap in the transition to more inclusive and facilitative leadership at the school site.

Any appearance of newly emerging leadership roles of secondary chairs in a reform context would shed light on policy and training issues associated with high school restructuring. Will chairs have central roles in restructured schools, given the strong emphasis on collegial planning and interdisciplinary teaching (Task Force on High School Restructuring, 1993; Sizer, T., 1992) or is the position destined to become obsolete given its traditional lack of attention?

What are the noteworthy aspects of the roles of department chairpersons involved in implementing both mandatory and voluntary reform initiatives in Kentucky? In the present study, we undertook a two part investigation in order to determine how secondary department chairs are currently functioning in reform efforts and how teachers feel department chairs could function more effectively. We surveyed a representative sample of department chairs concerning general roles and responsibilities. Additionally, teachers within selected departments were surveyed for their perceptions of three areas: actual and desired responsibilities of department chairs, degree of involvement in innovation, and collegiality within departments.
The Teacher Leadership Project was started in the summer of 1997 with a core of 27 teachers from schools across the state. Initial participants developed a vision, mission, and a model for creating technology-rich classrooms and integrating technology into curriculum. Since that time, program funding has increased and the project has expanded considerably, adding 185 teachers during the 1998-99 school year, and 215 more teachers during the 1999-2000 school year. An additional 1,000 grade K-12 teachers from public and private schools in Washington were selected to participate in the program for the 2000-2001 school year, and it is anticipated that 2,000 more teachers will be added over the next two years.

Each TLP grant recipient receives, through their district, $9,000 worth of hardware and software, including a laptop computer, printer, and presentation device. Computers are provided at a 4:1 student to computer ratio, and recipients receive Office software, as well as Encarta Reference and Africana, Publisher, Front Page, and access to SchoolKit. Teachers are also provided with 11 days of training over the course of their first year in the program, attending a 5-day summer session, and three 2-day sessions during the school year. Training sessions are intended to help teachers (1) develop technical skills, (2) design curriculum that utilizes technology and is aligned with the state’s Essential Academic Learning Requirements, and (3) identify leadership opportunities for sharing their knowledge and skills.

TLP participants are grouped geographically for training sessions, and each “regional” group typically consists of 25-30 teachers. Regional coordinators, each of whom is supported by several other trainers, as well as a technical support person, lead the sessions. Coordinators and trainers come from within the TLP, having participated in the program for at least a year prior to taking on this leadership position. Teachers bring their laptops to training sessions, enabling them to share materials and experiment with software during their time together. Training sessions, which are held in hotel conference rooms across the state, are intense and include instructional time (philosophy, research, curriculum design and alignment, software and skills, etc), help desks (short sessions which are focused on specific technical issues), sharing, and goal setting. In addition to attending all training sessions, teachers also agree to participate in the evaluation of the project.

Each participant’s school district must meet certain requirements to support their TLP teachers. Most importantly, the district must (1) agree to provide release time and classroom coverage so that teachers can attend training sessions, and (2) agree to provide technical support to maintain the equipment.

This paper describes a new capacity-building role designed to promote tighter connections between the macro aspects of instructional leadership and more micro-level classroom practices. Positions for “reform coaches” have been developed in a number of schools and districts in the Bay Area School Reform Collaborative (BASRC), a foundation-funded non-profit school reform organization that provides grants and professional development support to schools and districts in the San Francisco Bay Area. Here, we examine the reform coach role, the functions it provides to the system, and its potential as a capacity-building strategy.

Because the coach role is focused on capacity-building, it is important to clarify how we define this term at the outset. Building capacity in a school refers to the development of skills and knowledge in both individuals and in the organization as a whole. It often involves creating new structures and roles to broaden participation. Building capacity for changed practice is a critical, through often under-specified, aspect of instructional leadership. It involves:

• Building capacity for instructional leadership at the school level
• Managing knowledge resources by, for example, connecting teachers to relevant academic research or organizing student data into a format that is accessible to teachers
• Direct coaching of teachers on topics related to their practice, such as literacy or differentiated instruction
• Building capacity for instructional support amongst teachers to support their peers

These functions are based both on our observations of the actual enactment of the role by the coach, as well as our interpretation of the roles they play that are distinct from other actors in their schools.

Research Questions and Methodology
This paper presents the results of a study examining the role and activities of reform coaches in BASRC. Three questions guided this work:

• What does the role of the reform coach look like? What functions do reform coaches perform?
• How do they negotiate their role in the system?
• In what areas are coaches experiencing success in building capacity? In what areas are they experiencing the greatest challenges?
This study examined the characteristics and behaviors of middle school mathematics teacher leaders in their classrooms. Data were collected from four separate school districts.

Interviews were conducted in conjunction with ethnographic observation. The Teacher Roles Observation Schedule (TROS) instrument was used to record observations of a teacher leader’s classroom behavior. The instrument provided ten intervals for ten separate observations. The observer watched the teacher leader for ten separate 60-second intervals and recorded as many teacher interactions, settings, purposes, and natures of teacher inactions as possible. Teachers were observed non-continuously to facilitate a wider sample of observations.

The questionnaire used the peer nomination technique. Middle school mathematics teachers were asked to recommend a peer who he or she felt was a teacher leader in the middle school mathematics classroom. Furthermore, the teacher was asked to specify the characteristics that made his or her nominee a teacher leader.

Questionnaires were sent to middle school mathematics teachers in four school districts. Sixty-three teachers responded for a response rate of 56%.

There were 20 teachers who were nominated as teacher leaders in the middle school mathematics classrooms. Upon contact, three of the 20 teachers declined to be involved with the study. Two of the remaining 17 were in school district leadership positions related to district mathematics professional development and curriculum management. These two were no longer in the classroom and were unable to respond to a majority of the interview’s items.
Springfield’s mathematics teacher leaders, curriculum leaders and superintendent decided in the fall of 1997 to adopt TERC’s Investigations to strengthen their district’s elementary mathematics program and align the elementary curriculum with the district’s previously implemented standards-based middle school mathematics curriculum. Until 1998-99, this school district’s elementary school teachers were given considerable autonomy over their classrooms’ mathematical content and instructional practice. The mathematics curriculums specialists advocated for the use of Marilyn Burns’ replacement units (Correspondence, June 1999) but teachers only requirement was to cover a given number of topics by the end of the school year with whatever text materials they wanted to use. In the fall of 1997 this district, which has a reputation for strong academic achievement, received disappointingly low test scores on the state’s new mathematical assessment of student learning, otherwise known as the WASL. To improve their test scores, the superintendent mandated that the whole district move to one coherent mathematics curricular program that reflected the state’s Essential Academic Learning Requirements (EALRs). The Springfield district employed teacher leaders at each school to support elementary teachers during the implementation of TERC’s Investigations. In 1998, the district created teacher leadership teams in order to provide staff development in a cost efficient manner and get important information about the curriculum to the teachers. Three teacher leaders and their principal from each school participated in professional development programs offered over the course of the academic school year. Teacher leaders were chosen by their principals or volunteered for the position. Each teacher represented a K-1, 2-3, or 4-5 grade cluster.

The school district also provided optional summer and after school workshops for all the elementary school teachers. Attendance at these workshops is by choice and teachers received reimbursement pay for their time. However, the district required that teachers spend 28 hours participating in compensated professional development programs each academic school year, so many teachers use these mathematics workshop opportunities to fulfill the district’s professional development requirements. For those elementary school teachers who do not attend these mathematics workshops, the main avenue for staff development on TERC’s Investigations was through their teacher leaders or at the all day grade level mathematics staff development meetings offered twice a year. According to the curriculum specialists at Springfield district, teacher leaders were seen as communicators between district leaders and classroom teachers. They were also seen as facilitators of in-house professional development experiences related to TERC’s Investigations material.

**Teacher Leaders Providing Administrative Support**

Providing administrative support for classroom teachers was the predominant role teacher leaders employed. Teacher leaders gathered and organized manipulative materials and curriculum texts for teachers, and they collected assessment pieces from each curriculum...
unit for the district’s executive directors. They also gathered other needed supplies such as Lieberman, Saxl, and Miles (1988) found in their study.

**Initiating Earth Systems Education**

The goal of Earth Systems Education is to infuse Earth systems concepts throughout the curriculum at all grade levels, K-college. The approach taken by leaders in this effort has been to rely on teachers, for experience demonstrates that teachers can implement lasting change by believing in the need and becoming part of the process. The top-down approaches of major curriculum restructure programs have great visibility and political power because of the entities sponsoring them, but unless teachers accept the proposed changes and their role in those changes, the efforts will fall short of their potential. ESE, then, has been propelled through teacher enhancement programs both at the origin (The Ohio State University) and in other parts of the country. Summer workshops, leadership opportunities for teachers, and networking have begun to result in grassroots changes in participants’ schools.

In 1990 the National Science Foundation funded a three-year project entitled “Program for Leadership in Earth Systems Education,” with the acronym PLESE. The principal program components were intensive three-week summer workshops designed to

- Provide teachers in grades 4-12 with up-to-date information on global change issues,
- Acquaint them with constructivist learning approaches so they could effectively help learners to acquire science knowledge,
- Equip teachers with integrated Earth systems activities that they could use in their own teaching, and
- Help teachers develop skills to conduct their own workshops, thus extending the reach of the project to others in participants’ local education environments.

Teachers were recruited in five-person teams to attend workshops with others from their region of the country. Teams were to consist of a teacher in each grade level – elementary, middle and high school – plus a college teacher and a school administrator from their area who could serve as facilitators for the teachers’ follow-up work with the project. The three teachers participated together for three weeks in a workshop either at The Ohio State University (OSU) in Columbus, Ohio (for those in the Northeast, Southeast, and Great Lakes regions) or at the University of Northern Colorado (UNC) for those in the Pacific or Midcontinent regions. The administrators and college liaisons for these teams joined the teachers for a three-day period near the end of the workshop. Over the course of the project, fifty-eight teams with teachers representing 36 states participated in the summer workshops.

During the workshops, college faculty from the lead institutions, along with local teachers who had demonstrated leadership capability and interest in curriculum restructure, provided experiences focused on the workshop goals. For up-to-date science, each workshop had the services of three to four leading scientists who agreed to spend
the same four days with participants as the teachers studied about the scientists’ specialties. In cooperative learning sessions (jigsaw method) teacher groups first learned about the science topic through selected articles and a scientist, then taught the topic to teachers at their own grade level with the scientist in attendance. Over three days the teachers and scientists learned from each other. The scientist was able to see how teachers understood and planned to use the information, and the teachers came to trust the scientist as a person and their peers as teachers (Mayer, Fortner and Hoyt, submitted).

While science updates occupied most of the first week of the workshop, the work of the second week was also introduced at that time. Teachers from the same local team were to work together on development of a resource guide that would include exemplary ESE-type activities and reference materials designed to answer questions about an Earth system topic in relation to the framework of Understandings. The development of the advance questions was critical to this effort. Those who believed in ESE as a model for curriculum structure are accustomed to thinking about classroom subject matter being selected in answer to questions. If there is no question to be answered by an activity, why do it? Construct good questions, then, is to develop a curriculum design that has relevance.

In addition to giving substance to how ESE might integrate science in their classrooms, this exercise was designed to encourage articulation of subject matter across grade levels and build a team spirit by region. As in the science jigsaw, time was allotted to share resources within grade levels as well, so that all elementary teachers, for example, would become aware of exemplary materials on the range of Earth system topics being explored by all groups. Throughout this period, project staff integrated ideas for application of classroom computer technologies and demonstrated alternative assessment techniques useful in evaluating group learning.

The final week was spent in learning how to present a workshop to other teachers. While some participants were experienced in this, a large majority of teachers indicated that they had never made a personal presentation to their peers before. Since the NSF funding included support for workshops to be conducted by the teachers in their home regions, it was important to assure that participants were prepared to accept that responsibility. With project staff oversight, groups of two or three teams worked together to design a three-hour workshop, which they presented to the other groups.

While completion of the resource guides and plans for peer teaching were in progress, the time came for the college and administrative liaisons to visit the workshop. After briefings on ESE philosophy and methods, liaisons joined their teachers to strategize about local efforts that could be accomplished by the group in the coming year. The liaisons were able to recommend audiences and conferences that would be appropriate to reach with ESE information and ideas, and in many cases liaisons became facilitators for the work of the teacher teams. Having representation of key support groups not only assisted the teachers, but also expanded ESE ideas into other colleges and served as program outreach for other teachers in the districts represented.
Other aspects of PLESE in addition to summer workshops included a quarterly newsletter, *PLESE Note*, which originated from the OSU project headquarters and included information from the teams, updates on science and new resources available to educators, calendar of opportunities, and articles of interest in curriculum restructure. At the end of the project the newsletter was reaching over 2200 readers. This activity of the project assured that participants and other interested people could be networked for sharing supportive information. An electronic bulletin board was also established, but even as the project came to an end the number of classroom teachers with access to electronic mail was very small.

As for leadership opportunities, the project was able to support key teachers who were restructuring their own curricula as a result of PLESE to attend national meetings and represent ESE for others. Teachers were supported to regional and national meetings of NSTA, the Geological Society of America, and Coalition for Earth Science Education. During the final year of the project, teacher leaders from each of the five regional workshops were invited to a final workshop at the Colorado center. This “summit” followed the same general plan of earlier workshops, but participants were charged with developing 1) a final set of exemplary activities and guidelines for others who would choose to infuse Earth systems concepts into their curricula, and 2) guidelines and suggestions for those interested in restructuring science education in entire schools and districts. The Resource Guide for Earth Systems Education, entitled *Science is a Study of Earth*, was initiated through these efforts as a final project of PLESE that could become the beginning of curriculum restructure for others.
Videodisc Curriculum  Prior to implementation, the four teachers attended two 1-hour training sessions in which they were provided with an overview of videodisc technology, a demonstration of how to operate the videodisc equipment, an introduction to Mastering Fractions curriculum, and guidelines for implementing the program in the classroom. This initial training taught some of the theory behind the program, demonstrated what a typical lesson should look like, and provided approximately 20 minutes of practice with the new technology.

The quantity and nature of the training were designed to parallel what is generally provided by publishers of standard curricula. The teachers were encouraged to spend time familiarizing themselves with the equipment and the content of the lessons before presenting the first lesson to their students.

Beginning in early October, participating teachers used the Mastering Fractions program with their students for a period of 6 weeks. The number of lessons each teacher covered during this time was contingent upon the day-to-day progress of the students. Most covered 20 to 25 lessons.

The teachers were “coached” for a designated period of time by the second author, an experienced special education teacher trainer familiar with both the instructional design and the technological features of the videodisc, as well as with research-based instructional strategies for teaching students with disabilities.

Coaching Coaching consisted of classroom observations, provision of specific feedback to the teachers on those observations, and evaluation of the changes and improvements in teacher performance and the impact on the students. In addition, the coach attempted to provide support for the teachers as they went through the process of implementing new teaching strategies.

The coaching process centered on instructional variables and issues deemed essential by the researchers based on our understanding of the principles underlying the program and the research on effective mathematics instruction for students with learning disabilities (Cawley, 1985; Engelmann et al., 1991; Gersten et al., 1986). Five aspects of implementation served as the focus of the observations and post observation coaching lessons:

- Using clear, consistent language and providing explanations congruent with the videodisc curriculum’s conceptual framework;
- Spending sufficient time on each concept so that the entire group can successfully solve problems;
- Providing students with informative feedback when errors are made; and
- Avoiding criticism and providing encouragement and praise to students.
The coach’s verbal and written feedback was intended to be constructive and nonjudgemental. It dealt with positive aspects of the observed lesson, as well as areas where improvement was desirable. The coach virtually always phrased her comments in terms of student learning and observed student behavior rather than teacher performance (e.g., “Sometimes, several of the students are waiting while you check individually whether everyone has each problem completed. Focusing a little more on your lower performers and spot-checking the others might let you pace things a little more quickly for the others.”).

Occasionally the coach provided brief, in-class demonstrations or models of new techniques to further clarify the desired teaching behaviors. At other times, she made suggestions only. The suggestions were followed up in subsequent feedback sessions in her written comments regarding teacher and student progress.

Issues raised by the teachers were addressed during the feedback sessions. When responding to the teacher concerns about problems in learner behavior, the coach always stressed the link between the teacher’s use of an instructional strategy and the students’ learning performance. The coach tried to subtly shape the teachers’ thinking about instructional interactions so that they came to better understanding the relationship between their teaching actions and student learning and behavior (Kennedy, 1991; Leinhardt & Greeno, 1986; Woodward & Gersten, 1992).

The coach also responded to logistical questions about the technology (e.g., how to operate the remote control device, where to position the monitor for best viewing), offered advice on optimal teaching behaviors for effective implementation of the program (e.g., providing feedback after quizzes, checking student classwork), and suggested classroom management strategies (e.g., seating of difficult students, reinforcing appropriate verbal responses).
This paper aims to explore how teacher leaders help teachers improve mathematics and science teaching. Research focused on a purposive sample of seven teacher leaders selected to vary in their time allocated to teacher leader work and their content knowledge. Each teacher leader was interviewed, as were two teachers and at least one administrator working with that teacher leader. Each interview was first subjected to a mix of deductive and inductive coding before a case study was written for each teacher leader. Teacher leaders conducted two sets of leadership tasks. The paper finds that support tasks helped teachers do their work but did not contribute to teacher learning. Developmental tasks did facilitate learning. All teacher leaders engaged in support tasks, but only four did developmental tasks as well. Teacher leaders who engaged in developmental tasks had access to one material resource and three social resources not available to other teacher leaders: time to work with teachers, administrative support, more positive relations with teachers and opportunities to work with teachers on professional development.

Methods
This study is part of a larger study of teacher leadership undertaken in the context of the implementation of the New Jersey Math Science Partnership. The New Jersey Math Science Partnership (NJ MSP) was a collaboration among two universities and 11 school districts to improve students’ achievement in mathematics and science across all grade levels. An important theme of the partnership was to strengthen organizational support of inquiry-oriented instruction. One way to do that was to conduct summer institutes for teacher leaders. In conjunction with these institutes, the NJ MSP encouraged partner districts both to integrate teacher leaders into their school improvement planning and to provide teacher leaders with the support needed to effectively sustain such improvement.

This study was conducted in a qualitative research tradition, specifically as a comparative case study using a naturalistic approach (Marshall and Rossman, 1999). Information about teacher leaders’ work and the organizational factors influencing teacher leaders’ roles was collected from teacher leaders and other informants in the setting. Interaction with these participants in their naturalistic settings helped to better understand the situational factors at play within these contexts (Spillane et al., 2001).

Sample
The population from whom the sample was taken was the group of teacher leaders who participated in the 2004 Teacher Leader Institute (TLI). Purposeful sampling (Patton, 1990) was used to select the teacher leaders who would be “information rich” in terms of this particular study, three colleagues of each, and both the district administrator and building administrator of each. The teacher leader’s description of whom he/she most closely worked with determined the persons contacted for
interviews at each level. Each teacher leader provided names of his/her colleagues, three of whom were contacted for interviews.

This study was part of a larger investigation of teacher leadership by the NJ MSP. The larger study called for selecting teacher leaders who vary on two dimensions. The first was the amount of time teacher leaders are formally released to work with their colleagues. In previous studies, release time has been a substantial influence on the success or failure of a teacher leadership initiative (Lord and Miller, 2002). Release time affected teacher leaders’ opportunity to interact with their colleagues as part of their teacher leadership work. The other dimension on which teacher leaders were sampled was their content expertise (see Table I).

Seven teacher leaders from the 11 NJ MSP school districts who participated the TLIs during the summer of 2004 were chosen for this study. Three of these seven participated in the 2003 TLI and a pilot study conducted that year; therefore, in these three cases, longitudinal data were utilized. All the teacher leaders worked with teachers in kindergarten through grade eight. Six teacher leaders came from school districts that were among the poorest in the state. Five of these districts had student bodies that were predominantly Hispanic. The seventh teacher leader came from a district that was in the middle of the state’s income distribution and was predominantly white.

In addition to the teacher leaders, information was obtained from 19 colleagues of the teacher leaders (one to three for each of the seven teacher leaders) and 13 administrators with whom the teacher leaders worked (one was the district administrator for two of the seven teacher leaders). Some colleagues and administrators whose names teacher leaders provided to the researchers did not return calls and/or e-mails requesting their participation. In addition, one teacher leader in the non-content expert/no release time category requested that the researcher not speak to her building administrator.
The goal of the Science Quality Education Project was to train teachers to make more effective use of television as a teaching tool and encourage greater use of TVOntario’s science programming.

The project had two significant aspects. First, the SQEP experimented with a model of teacher in service training referred to as the trainer-of-trainers’ model. It was hoped that this method of training would encourage more substantial change in teaching beliefs and practices than the “one-shot” workshops TVOntario had used in the past.

Secondly, the project was significant in that its implementation was guided by the educational change theory of Michael Fullan (Dean of the Faculty of Education, University of Toronto). Fullan’s (1982) theory has described the factors influencing the implementation of change in educational beliefs and practices. Key concepts from this theory were incorporated in the project planning.

The Science Quality Education Project was implemented at four curriculum levels (Primary, Junior, Intermediate, and Senior), each in a different board of education. The four school boards included: the Lincoln County Roman Catholic Separate School Board (Primary level), the Durham Board of Education (Junior level), the Timmins Board of Education (Intermediate level), and the Bruce County Board of Education (Senior level). The SQEP was administered by four TVOntario project leaders, and each project leader was responsible for a school board. The TVOntario project leaders were each paired with the leader of a board and together the two planned and conducted the training for that board. Since each board administered its own training, the SQEP was frequently described as four separate projects (i.e., a Primary project, a Junior project, etc…).

During the first phase of the project, roughly spanning the time period from January 1987 to June 1988, the TVOntario project leaders worked closely with the boards to organize and begin the training sessions. In the second year, from September 1988 to June 1989, teachers practiced their training and initiated others. Both phases of the project have been documented by TVOntario’s Evaluation and Project Research Branch (see Glegg, 1988, 1989).

Beginning in September 1989, the SQEP entered its third year. As planned, the boards assumed full ownership for their projects, while TVOntario limited its involvement to a consultative role. It was hoped that during this third year, teachers would continue to apply their training to their own teaching and at the same time, continue to affect change in others.
The Trainer-of-Trainers’ Model

The trainer-of-trainers’ model of in service teaching is a relatively new model for TVOntario, though it has been used elsewhere. TVOntario’s first experience with this model was in the “Renfrew Quality Education Project” (Sharon, 1987).

In this model, the training is first concentrated on a small group of carefully selected teachers. After this “model” group is trained, they then become trainers for their colleagues. The colleagues then train others, such that the effects of training continue to ripple throughout the school board.

In the past, projects using this model have employed a variety of methods to extend the training beyond the original group. The “Renfrew Quality Education Project,” for example, used what was called the “collegial approach,” where the first group of trained teachers modeled their newly acquired skills for colleagues. The teachers in the SQEP used a variety of methods including: informal sharing with colleagues, workshops, and peer coaching as described by Joyce and Showers (1980).

To apply this model of training in the SQEP, a small group of teachers was selected in each of the four school boards. Within each of the boards, this small group – who were sometimes referred to as the model teachers - met on a regular basis during the first eighteen months of the project. These meetings typically occurred once every month or every two months.

The content of the training sessions varied somewhat from board to board but generally addressed many of the same topics. Teachers were taught the proper use of equipment and shown techniques for using videotape television more effectively in their teaching. These included: showing segments of programs, starting and stopping the tape for discussion, pausing, replaying, or turning the sound off to encourage more independent thinking. The aim of the techniques is to enhance students’ interaction and involvement with the videotape presentation and thereby improve learning. The participants were also instructed on the importance of fostering in their students critical television viewing skills and a better appreciation of television’s unique communication capabilities.

Another purpose of training was to familiarize teachers with TVOntario’s science programming and show them ways in which the programs could be related to the curriculum and integrated with follow-up activities. In some sessions, teachers were encouraged to develop lesson plans incorporating videotape television with other curriculum-related activities in an integrated unit of study.

Teachers were also taught some of the basic principles of adult education, particularly with regard to giving workshops or making presentations. Some of the groups also experimented with “innovation Profiles” – a self-evaluation scheme developed by Ken Leithwood at the Ontario Institute for Studies in Education. Using this scheme, the groups created a profile of the skills of a successful television-using teacher; the skills were then organized along the continuum of increasing proficiency. The continuum provided a benchmark against which teachers could evaluate their progress infusing
television more effectively.

The training in the Primary- and Junior-level projects differed in that greater emphasis was placed on using television in conjunction with a child-centered activity-based approach to science instruction. The Intermediate- and Senior-level projects experimented with computer conferencing.
This study examined factors that influence K-5 teachers’ technology integration efforts during a semester-long Collaborative Apprenticeship. Teacher-leaders initially modeled exemplar applications of technology-enhanced lessons and gave advice on their classroom use. Subsequently, the community of teachers brainstormed ideas collaboratively as teacher-leaders supported peers to develop original lessons independently.

Collaborative Apprenticeship has been proposed as a framework to support teaching communities during the school day and applied to promote technology-enhanced curriculum and teaching practices. Teacher leaders with advanced knowledge, skill, and experience provide situated, ongoing, just-in-time support to peers as they develop and refine knowledge, skills, and resources to use in their classrooms.

**Study setting**
A suburban elementary school located in the southeastern United States. Fifth-grade teachers were purposely selected. Roughly 45 minutes of shared planning time and space were allotted per day for grade-level teams to meet. Two teacher leaders and nine peer teachers participated in the study.

The first author, as participant-observer, introduced the structure of Collaborative Apprenticeship, collected data, responded to the teacher leader thoughts and concerns, and supported them through the mentoring process. Primary data sources included interviews, field notes, and reflection journals. Interviews, conducted before implementation to characterize participants’ knowledge and use of technology and support for peer learning and development, were shared with teacher leaders. Throughout the study, we conducted informal interviews in response to teachers’ needs or requests for clarification. We also conducted a post-interview upon completion of the study to assess technology use, to identify factors and interactions, and to establish how or whether teachers planned to continue the technology integration process. All interviews were transcribed. Field notes, focusing on support needed to integrate technology effectively, were collected on 15 occasions to document interactions during planning meetings and in shared work areas. We documented the first-author’s participation with the teacher leaders to guide analysis of the field notes. As teachers implemented technology-enhanced activities, they wrote reflection statements about the activity and their plan for subsequent efforts. Teacher leaders maintained biweekly journals to document support of peers’ development and strategies used for collaborative planning.

**Analysis**
Nine preliminary reciprocal interactions elements and six related elements were used to organize data. Thematic analysis of the coded data initially focused on patterns that emerged in prevalent reciprocal interactions and factors. As data were added, initial
assertions were generated regarding relationships and distinctions and refined based on new information or discarded in the presence of conflicting information until saturation. More than 200 assertions were posited by a six-member research team to account for the classifications. Findings were shared for a member check with the teaching community and codes were revisited to resolve assertions in questions.
In this study we have used a hierarchical type of cluster analysis to construct empirically based configurations on the basis of our indicators of effective and coordinated management. Cluster analysis was carried out on all indicators of effective management (see Table 1). In order to do so the scales had to be converted into $z$-scores first. Table 2 presents the results and shows three empirically based types of management, using descriptive scores of the $+$, $0$ and $-$ type, based on the significant deviance of the clusters per indicator (significance level of $p < 0.05$). Note that only variables/scales that significantly differ between the three clusters are presented in Table 2.

The first management type (cluster 1) concerns more than half of the secondary schools in our sample of 91 schools. This management type has modest scores regarding the ‘mutually adjusted influence structure’ in the school’s management, meaning that the contact between school and parents is modest and school parties exert little influence on the school board’s decision-making policy. The departments’ influence on school policy and on decision-making processes regarding instruction seems insignificant. At the school level, the coordination mechanisms’ ability to create an orderly climate is modest and, at the department level, it is insignificant once again. This type of school scores relatively low on collaboration and mutual agreement between teachers within the department. A positive element of this type of school is the relatively low cancellation of lessons, and the amount of time available for learning is, in general, adequate. At the department level the focus on staff development is only modest. Finally, in this type of school, school heads and department heads reveal a modest cohesion within their own working environment. We can typify this type of management as modest school-based leadership, with a low degree of departmental leadership.

The second management type (cluster 2) is more difficult to describe because it shows a lot of variation in our indicators of effective school and departmental leadership. This type holds approximately one third of the secondary schools in our sample. A mutually adjusted influence structure has not (yet) been developed and, in particular parents, have less contact with the school than parents in other leadership types. Additionally, the influence of school parties on the policy of the school board is low. Departmental influence on policy and content of education is modest. At the school level almost no coordination mechanism is used to create an orderly climate. The situation is somewhat better at the department level as there is some sort of collaboration between the members. Variation is apparent as well in the availability of learning time. At the school level the cancellation rate is modest, while it is more substantial at the department level. However, at both levels efforts are made to encourage staff development. Finally, there is a lack of shared consensus and vision at both school and department level. This type of leadership could be typified as a varied style of leadership lacking consensus.

Our third management type (cluster 3) is clearly the opposite of the first and the second
types. Schools with this type of management combine effective school leadership with effective departmental leadership. Only 13% of all secondary schools in The Netherlands qualify as this type. These schools make use of mutually adjusted influence structures, through which the various school parties are able to exert strong influence on the decisions of the school board. Departments exert substantial influence on school policy and on the content of schooling in general, and some influence on the primary schooling process in particular. Educational leadership of the departments focuses on the instructional process. At the school and the department levels the conditions for an orderly and positive climate are well developed. Furthermore, consensus on general educational aspects and on department specific aspects has been developed to a great extent, and collaboration between teachers in the departments seems high. The only aspect on which school and department levels do not seem to be in line with each other is in the available learning time, which seems low at the school level and high at the department level. Schools of this management type show strong staff development and relatively high consensus, at both levels, on educational policy, content, didactical and pedagogical strategies and on applying useful teaching practices for special needs students and for students at risk. Such consensus is also present for matters of personnel, finance and school improvement. All in all it seems appropriate to typify these schools as possessing an effective, cohesive and coordinated leadership style.
The purpose of this study was to assess the effectiveness of a Local Systemic Change (LSC) initiative ($N=216$) at Year 2 in a 5-year plan. Key questions were: What is the extent of school and teacher involvement? What is the impact on teacher preparedness, attitudes, and beliefs? and What is the extent of institutionalization? The model of professional development used shared leadership (Lead Teachers & Study Groups) along with workshops in inquiry, content, and assessment. All teachers averaged 81 hours of participation by the end of Year 2; LTs averaged 161 hours. Longitudinal and episodic data were collected using multiple instruments, including Horizon Research Teacher Survey (Baseline and Year 2), SG and Lead Teacher surveys (Year 1 and Year 2), Context Beliefs About Teaching Science and Classroom Observation Protocol (Year 2). Gains in teachers’ practices, beliefs, and professional culture (collegiality and department chair support) were measured at significance levels of .05. The results indicate that sustained and intensive professional development influences individuals and school culture.

The secondary science LSC under study, Science and Technology for Understanding Research and Networking (SATURN), builds on two prior country-wide initiatives that were designed to improve the teaching of elementary science. The objectives of SATURN are (a) to develop an articulated and sequenced science curriculum based on national and state standards, (b) to implement exemplary instructional materials, (c) to create local leadership teams, (d) to educate teachers in standards-based science content and pedagogy, and (e) to promote student achievement.

All LSC initiatives require participants to engage in a minimum of 130 hours of professional development over a 5-year time period. Saturn uses three main professional development strategies: content and pedagogy workshops, LT meetings, and SG (peer groups). The latter two strategies were selected to encourage development of a culture of shared leadership within the school community.

During the first two summers (Year 1 and Year 2), the inaugural (required) 30-hour session Intro to Reform was offered for all new participants. Both teachers and administrators participated in the session. Intro to Reform summarized major issues surrounding the science education reform movement, including influence of inquiry on curriculum and assessment, the role of national and state standards, and use of reform-oriented instructional strategies and materials. Optional workshops, each ranging from ½ day to 2 weeks in length, addressed leadership and facilitation strategies, inquiry, authentic assessment, instructional materials, science content, classroom management, and instructional technology to be selectively applied by teachers in their own practices. Inquiry strategies were a major thread in all sessions. During the first 2 years of the project, more than 160 days of workshops were conducted. Additionally, presentations about SATURN’s progress and goals were routinely made at district-wide administrative meetings by members of the Program Management Team.
Teacher participants were offered various forms of professional development, including workshops, SG, and LT meetings, as appropriate. Workshops conducted during the summer and the academic year modeled the use of constructivist pedagogy in teaching content-rich workshops in geology, biology, physics, and ecology. Some workshops focused on development of performance assessment instruments, use of cooperative learning, and conceptual change teaching. Workshops in instructional technology and content-specific technology (for biology, chemistry, and physics) were also offered.

Shared leadership, an essential design element of this initiative was developed through several components. The Program Management Team (PMT), consisting of the Principal Investigators and six exemplary teacher leaders, is responsible for planning, designing, and providing many of the professional development opportunities.

A second component of shared leadership is the development of a corps of 44 LT, representing each of the 44 middle school and high schools in the county. Initially selected by their local curriculum directors using a set of screening criteria, LTs committed to take leadership roles in their districts for the 5 years of the project. Screening criteria included demonstration of (a) collegial leadership at the building or school district level, (b) initiation of curricular or instructional innovation, and (c) effective communication skills. All LTs jointly participated in 2-hour monthly meetings during the academic year. Discussion topics included facilitation strategies, self-knowledge about leadership styles, national and state standards, state-mandated proficiency tests, student work, action research, constructivism, and performance-based assessment. In turn, the LTs were responsible for meeting with their district colleagues (non-LTs) in SGs for an additional 15 hours per academic year. In study groups, LTs applied their knowledge and skills to facilitating discussions and problem-solving sessions addressing school-based concerns. While each SG self-selected their area of focus, most groups worked on curricular scope and sequence, statewide testing mandates, and standards-based instructional materials. Building principals were kept informed of the SG meeting times and topics, and were invited to attend. LTs were responsible for reporting the annual accomplishments of SGs using the LT Survey form. All teachers, LTs and non-LTs, evaluated the effectiveness of their particular SG using the Study Group Survey form.

The present study sought to understand how a peer coach for teachers may influence teachers’ understandings and abilities to facilitate differentiated lessons for high-ability students. In the current study, the researchers sought to explore the feasibility of a peer-coaching program, with the aim of enabling teachers to enhance their knowledge and application of differentiation in a mixed ability classroom. Specifically, the research questions guiding the study were (1) “What were the mentors’ perceptions of their participation in a peer coaching program design to enhance teacher understanding of differentiation in a mixed ability classroom?” and (2) “What were the teachers’ perceptions of their participation?”

Project CLUE (Clustering Learners Unlocks Equity) is a partnership between Ball State University and Indianapolis Public Schools. Mentoring in Project CLUE is a strategy to meet goal three, to provide teachers with a knowledge base with regards to best instructional practices for GT (Gifted and Talented) students and differentiation strategies, mentoring relationships were created between IPS teachers and qualified peer coaches. During the spring terms of 2004, 2005, 2006, mentors conducted in-class observations with third-, fourth-, and fifth- grade teachers on three separate occasions. Groups of teachers receiving the CLUE curriculum were provided lesson plans and training on curriculum implementation. Mentors were assigned a small number of teachers from a particular group. The mentors served not only as observers but also as colleagues or peer coaches. Each mentor/teacher duo kept in touch via phone or e-mail in order to schedule visits and discuss ideas, strategies or differentiation techniques.

Teacher professional development was the primary mission of the mentoring program. The fact that the program was non-evaluative in nature was made clear to all mentors and mentored teachers. A total of 46 IPS teachers were mentored for 1 to 3 years by nine mentors. Mentors served several teachers simultaneously.

Caucasian women represented 95.2% of teachers participating, all teachers had at least 1 year of teaching experience. Mentors were recruited and selected based on affiliation with IPS schools, GT consulting experience, BSU affiliations and geographic proximity. All mentors had at least 15 years of teaching experience, ranging from 15-33 years. Each mentor received a stipend as well as travel reimbursement. Caucasian women represented 78% of mentors.

Methodology
During the spring terms of 2004, 2005, 2006 mentors conducted three in-class observations per term with each of their assigned teachers. Observations were recorded using an instrument designed specifically for this purpose: The Project CLUE Mentor Log (CML). Each pair used e-mail as a primary communication tool. A content analysis of the CML and email correspondence between teachers and mentors was conducted. The nine mentors and 46 mentored teachers were provided surveys in the spring of 2007 regarding their impressions of the program. Seven of the nine mentors returned a survey
(response rate 78%) and 30 of 46 teachers (65%). A content analysis was conducted on the survey data. Grounded theory was the basis for analysis. An outside note packet was generated in order to code data accordingly. After the coding was complete, coded data were transcribed into an electronic format and organized into thematic categories.

This inquiry examines the personal attribute and environmental factors that contribute to and impede science teacher-leader development. Using a narrative approach, the inquiry focuses on the experiences of three teachers in three different New Zealand primary schools (Years 1-6) as they develop their capabilities as science teacher-leaders during sustained school-wide science delivery improvement projects. Bronfenbrenner’s bioecological model and Rutter’s views on resiliency are used as a foundation for interpreting the science teacher-leader development process. Teachers identify a variety of personal attribute and environmental factors and the interplay between these factors as a risk and supportive factors contributing to and impeding their development as science teacher-leaders. Teachers also identify that their development is influenced by several proximal processes that are context and time dependent.

This study focused on eight teacher leaders who participated in a professional development program for teacher leaders—the Teacher Leader Institute—presented by the New Jersey math Science Partnership (NJ MSP). The NJ MSP was a consortium of two universities and 11 school districts working together to improve student achievement in mathematics and science through a variety of means. One strategy was to strengthen leadership for change, in part by helping districts to identify and prepare teacher leaders to support other changes being supported by the MSP. TLIs were held in the summers of 2003 and 2004 with follow-up activities during the year and the following summers. Districts sent cohorts of teacher leaders to develop a vision for improved math and science instruction, improve their content knowledge, and learn how to work with their peers.

A two-person team observed the 2003 TLI for two days and interviewed 18 participants. These observations were repeated during the 2004 TLI. More important, a sample of eight teacher leaders was identified to follow during the upcoming academic year to learn about a variety of issues, including how their content knowledge influenced their work as teacher leaders. Here we briefly describe the sample, methods of data collection, and data analysis strategies.

Sample
A purposive sample was selected among participants in the 2004 TLI to obtain variation on two dimensions. The most important was content expertise. A content expert was defined to have a minimum of an undergraduate major in the teacher leader’s content area and teaching certification in that area. A non-content expert was defined to be a teacher leader without a major and certification in the content area, either mathematics or science.
This ethnographic study investigated the implementation process of mathematics curriculum initiatives designed to improve student achievement in a test-driven accountability environment. The research focused on complex factors within the school contextual environment influencing implementation and student achievement specifically, leadership; school culture; and teacher’s attitudes, beliefs, and concerns.

The mixed methodology included statistical analysis of changes in state assessment scores of eighth grade students over a two-year period in four middle schools. The larger qualitative component involved the researcher, as participant observer, collecting data on implementation levels, leadership characteristics, elements of school culture, and individual teacher’s attitudes, beliefs, and concerns. Informal interviews and observations of 26 mathematics teachers and school leaders were conducted over a period of 12 weeks. In addition, teacher Concerns Profiles were developed from the Stages of Concern Questionnaire (Hall & Hord, 2001). The resulting profiles of school culture, leadership elements, and teacher’s attitudes, beliefs, and concerns were analyzed for patterns and themes related to implementation levels and changes in state assessment scores.

Findings indicated a relationship between: (1) the level of implementation of the curriculum initiative and improvements in state assessment scores and (2) a teacher’s Stage of Concern and their level of implementation. Additionally, the study identified potential influences on teacher’s attitudes, beliefs, and concerns including (1) the Form of instructional team/grade level subculture; (2) the support of team/grade level leaders; (3) the depth to which overall school leadership supports the curriculum initiatives; and (4) the availability of time to implement the initiatives.

The conclusions confirm existing research on the influences of individual teacher’s attitudes, beliefs, and concerns on their classroom practice while underscoring the importance of distributed leadership and collaborative instructional cultures in schools if improvement initiatives are to have the intended impact on student achievement. The study adds clarity to the complex set of factors within a school that can facilitate or impede successful implementation of curriculum initiatives designed to improve the achievement of all students.

Research Questions

- What was the influence of principal and curriculum leadership on teachers’ attitudes beliefs, and concerns?
- What was the influence of school culture on teachers’ attitudes, beliefs, and concerns? (note: while this is posed as a separate research question, findings re: leadership are discussed in relation to findings re: school culture)
Intervention Curriculum Initiatives:

1. Restructuring of a block of time previously used for non-instructional purposes to provide additional mathematics instructional support to academically at-risk students.

2. The introduction of a Mathematics Coach to provide in-classroom support for teachers during their regular mathematics classes and during the restructured block of time designed to provide additional support to academically at-risk students.

3. The availability of additional resource materials specifically designed to focus teachers’ instructional practices to match the standards used for assessment at the eighth grade level by the test-driven accountability system.

The curriculum leadership structure in the district was in a state of transition. Prior to the 2004-2005 school year, curriculum coordination was provided solely by one Lead Teacher in each content area. These Lead Teachers had a reduced teaching responsibility and were available approximately 50 percent of the school day in order to provide curriculum support to other teachers in their subject area throughout the district. The type of support provided includes (1) curriculum and standards alignment; (2) selection and purchasing of textbooks; (3) staff development; and (4) communication between levels and grades within the department. The lead teachers were supported by department chairpersons in each secondary building. Most recently, the lead teachers, particularly in mathematics, reading, and language arts, were also responsible for assuring that the district met the mandates of the NCLB legislation. Because of these additional responsibilities, the district instituted a number of initiatives designed to assist the lead teacher of mathematics in addressing the requirements of NCLB. Beginning in the fall of 2004, the district hired two additional teachers to serve as Mathematics Coaches at the middle and high school levels. The Mathematics Coaches’ responsibilities included (1) communicating the mandates and expectations of NCLB; (2) coaching the teaching staff on the implementation of curriculum changes; and (3) tutoring students identified as academically at-risk in the area of mathematics. The Mathematics Coaches worked in cooperation with the mathematics lead teachers to support the implementation of curriculum initiatives designed to improve student achievement on assessments mandated by NCLB. The Mathematics Coach positions were a component of the overall district improvement plan designed to improve student achievement on state-mandated assessments.

The participant observer served in the leadership and support role of Middle School Mathematics Coach designed to provide curriculum support on the implementation of initiatives intended to improve student achievement on state assessment. The researcher was immersed in each school culture by working with the teachers on a weekly basis over a period of several months in the typical school and classroom setting. The theoretical framework of the CBAM provided guidance to the participant observer as teacher’s attitudes, beliefs, and concerns were probed to determine implementation problems. As a
result of these probes, support was targeted to overcome the problems in order to facilitate the implementation of the curriculum initiatives.

The goal of many of the curriculum initiatives implemented during the 2004-2005 school year involved changing the focus and flexibility of the Instructional Opportunity Period (a time in which students are exposed to a variety of different learning opportunities such as reading workshop, content area mini-units, activity periods, clubs & specific interests, interdisciplinary activities, academic assistance and tutoring and reward activities). The initiatives required teachers to focus the Instructional Opportunity Period toward the content areas of mathematics and reading. Moreover, students identified as academically at-risk received additional tutoring and support during this period from the Mathematics Coach.

Setting
Four middle schools in Neshaminy School District, a suburban Philadelphia school district.

Definitions
Leadership and curriculum support was loosely defined to include those persons in the position of principal, assistant principal, department chairperson, and building curriculum specialists. However, the study did not limit the investigation to these individuals citing Elomore’s (2000) distributed leadership within effective school cultures.

Stages of Concern Framework (from Concerns Based Adoption Model, Hall & Hord, 2001)
Self – Personal Stage: Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role with the innovation. This includes analysis of his/her role in relation to the reward structure of the organization, decision-making, and consideration of potential conflict with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.

Impact – Consequence Stage: Attention focuses on impact of the innovation on clients in his or her immediate sphere of influence. The focus is on relevance of the innovation.

Impact – Collaboration Stage: The focus is on coordination and cooperation with others regarding use of the innovation.

The Teacher Leader Institute was developed to provide training in problem-based learning for family and consumer sciences teachers (FCS) for a large Midwestern state. This included implementing critical thinking, National Standards for FCS, and process skills into the curriculum, and the development of authentic assessments. It was established to assist in building the teachers’ instructional and leadership capacities. A total of 25 Teacher Leaders were self selected from earlier participation in workshops sponsored by the Department of Elementary and Secondary Education. Teachers obtained support from their school administrators and signed a contract with the State Department before participating in the Institute.
The Teacher Leadership Project was started in the summer of 1997 with a core of 27 teachers from schools across the state. Initial participants developed a vision, mission, and model for creating technology-rich classrooms and integrating technology into curriculum. Since that time, program funding has increased and the project has expanded considerably, adding 185 teachers during the 1998-99 school year, and 215 more teachers during the 1999-2000 school year. An additional 1,000 grade K-12 teachers from public and private schools in Washington were selected to participate in the program for the 2000-2001 school year, and it is anticipated that 2,000 more teachers will be added over the next two years.

Each TLP grant recipient receives, through their district, $9,000 worth of hardware and software, including a laptop computer, printer, and presentation device. Computers are provided at a 4:1 student to computer ratio, and recipients receive Office software, as well as Encarta Reference and Africana, Publisher, Front Page, and access to SchoolKit. Teachers are also provided with 11 days of training over the course of their first year in the program, attending a 5-day summer session, and three 2-day sessions during the school year. Training sessions are intended to help teachers (1) develop technical skills, (2) design curriculum that utilizes technology and is aligned with the state’s Essential Academic Learning Requirements, and (3) identify leadership opportunities for sharing their knowledge and skills.

TLP participants are grouped geographically for training sessions, and each “regional” group typically consists of 25-30 teachers. Regional coordinators, each of whom is supported by several other trainers, as well as a technical support person, lead the sessions. Coordinators and trainers come from within the TLP, having participated in the program for at least a year prior to taking on this leadership position. Teachers bring their laptops to training sessions, enabling them to share materials and experiment with software during their time together. Training sessions, which are held in hotel conference rooms across the state, are intense and include instructional time (philosophy, research, curriculum design and alignment, software and skills, etc.), help desks (short sessions which are focused on specific technical issues), sharing, and goal setting. In addition to attending all training sessions, teachers also agree to participate in the evaluation of the project.

Each participant’s school district must meet certain requirements to support their TLP teachers. Most importantly, the district must (1) agree to provide release time and classroom coverage so that teachers can attend training sessions, and (2) agree to provide technical support to maintain the equipment.
This publication presents highlights from the 2001 National Board for Professional Teaching Standards (NBPTS) National Board Certified Teacher Leadership survey, which involved 2,186 questionnaires from the National Board Certified Teachers (NBCTs). They survey examined the leadership activities of NBCTs and how National Board Certification impacted their leadership.
The phenomenon of using progress monitoring data to inform literacy instruction was explored in the context of four schools during their 2nd year of Reading First implementation. Across schools, teachers reported varying levels of success with using data to inform instruction. A grounded theory model of how K-1 teachers worked with reading coaches to try to use data to inform instruction was developed through axial coding. The coach’s role was to help teachers access and interpret data and make informed links to reading curricula. Perceived barriers to the practice of using the data included lack of time and classroom management difficulties.

As part of No Child Left Behind, Reading First grants have been awarded to schools that have the lowest levels of reading achievement and socioeconomic status with the goal to bring all students up to grade-level performance in reading. Schools with Reading First grants receive professional development and must use approved reading programs and assessment plans as well as have school reading coaches. The teachers at Florida Reading First schools, as part of the assessment plan, also have access to online progress monitoring data reports about their students’ reading skills.

Our study was conducted in this context of Reading First schools where reading coaches were tasked to scale up the use of student assessment data to inform reading instruction.

Ten kindergarten and first-grade teachers and four reading coaches working at four Florida Reading First schools in one midsized school district were purposefully selected as primary participants. Survey data collected from all 30 teachers and 5 coaches were used to select the schools in which teachers were then selected for interview. A triangulation sample included the remaining teachers who originally volunteered to participate.

**Purposeful selection of schools.** Written survey data were collected from teacher volunteers (N=30) during the spring semester. The survey contained both open-ended and Likert-type questions on the use of progress monitoring assessment data. Teacher ratings of Likert-type items were quantitatively analyzed to identify schools at which teachers would be selected.

We decided to focus on selecting teachers for interview from Schools D and B [because D scored the lowest and B and highest]. School A also was chosen because the mean teacher survey score fell mid-way between those of Schools D and B. Of the two urban schools in the sample, School E was selected because it allowed us to include a more balanced number of teachers using the different core reading programs. From the four schools, 10 teachers were selected based on three criteria. The chief criterion was related to teachers’ open-ness or resistance to using data. Besides the coaches’ ratings, two additional criteria were considered in making the final teacher
selection: grade level taught and group assignment in a concurrent professional
development experiment. We wanted to evenly distribute these two variables across the
range of teachers’ levels of success, skills and attitudes about using data to inform
instruction.

For the interviews, we ultimately selected four teachers with consistently above average
ratings in each of the four areas, two teachers with consistently average ratings in at least
three of the areas, and four teachers who either were resistant to using progress-
monitoring data to inform instruction or were rated low in two other areas.
Pearson correlations were calculated between the three teacher skill and effectiveness
rating and the resistance rating. The correlations between the skills were all significant
and positive ($r \geq .55$, $p \leq .01$) while the correlations between the skills and resistance
level were all nonsignificant ($r \leq .33$, $p \geq .07$)

Semi-structured interviews were conducted during the last 2 weeks of school and into the
summer. Questions were used to prompt teachers to expand as much as possible on their
experiences with assessment data so as to obtain a clear picture of their use of assessment
data and how it influenced their instructional decision making. Interviews were based on
a framework of 28 open-ended questions. All interviews were conducted by phone and
lasted approximately 50 minutes each.

Data coding. Data were inductively analyzed following the grounded theory method.
We conducted open coding of the data from the interviews be rereading the transcripts
several times and descriptively labeling and combining all meaning units into related
groups. Relationships between categories were identified using the constant comparison
method. The confirmability of emerging categories and relationships between categories
were established by having the second author and the final author review the coding and
discuss disagreements until 100% agreement was reached.

Triangulation. Open-ended responses were collected on the survey administrated to the
original sample of all 30 teachers volunteering for the study. The 10 interviewed
teachers’ open-ended survey responses were included, along with their interview
responses, in the axial coding described above. The responses of the other 20 teachers
were also coded using the method described, with the emergent themes then compared
with the themes that emerged from the coding of the data provided by the primary
informants. Their responses were coded for any conflicting or new themes.

Credibility. Final data collection involved surveying the participating reading coaches to
establish the credibility of our interpretations drawn from the data. We sent a draft of the
emerging model described in the results below to the coaches of interviewed teachers.
Coaches were asked to review the model and provide any input regarding how well it fit
with their experiences and whether it contained any misrepresentations.

A large percentage of U.S. students attending high-poverty urban middle schools achieve low levels of science proficiency, posing significant challenges to their success in high school science and to national and local efforts to reform science education. Through its work in Philadelphia schools, the Center for Social Organization of Schools at Johns Hopkins University developed a teacher-support model to address variation in science curricula, lack of materials, and under prepared teachers that combined with initial low levels of proficiency block improvements in science achievement. The model includes a common science curriculum based on NSF-supported materials commercially available, ongoing teacher professional development built around day-to-day lessons, and regular in class support of teachers by expert peer coaches. One cohort of students at three Philadelphia middle schools using the model was followed from the end of fourth grade through seventh grade. Their gains in science achievement and achievement levels were substantially greater than students at 3 matched control schools and the 23 district middle schools serving a similar student population. Under school-by-school comparisons, these results held for the two schools with adequate implementation. Using widely available materials and techniques, the model can be adopted and modified by school partners and districts.

In this study, the author examines whether the Talent Development model improves science achievement.

The Talent Development model provides four tiers of support: (1) an implementable curriculum, (2) ongoing intensive teacher professional development, (3) in-classroom support from peer coaches, and (4) mechanisms to foster and sustain changes in science instruction, including opportunities for science teacher cooperation and development of teacher leaders.

The TD model uses science curricula developed with the support of the National Science Foundation including the Full Option Science System (FOSS) developed by the Lawrence Hall of Science, University of California—Berkeley, and Science and Technology for Children (STC) developed by the National Science Resources Center. These science materials focus on depth of understanding of a topic rather than breadth over multiple topics. Built around hands-on activities but requiring significant amounts of student planning and analysis, these materials allow students who may be behind in not only science but also reading and math to readily take part in lessons and learn the concepts and vocabulary.

Outside the classroom professional development is provided through a multiyear sequence of monthly workshops that is grade, curriculum, and content specific for which teachers can earn graduate credit. During the first year, the workshops focus on the materials and lessons teachers will be teaching in the next month, the content knowledge behind the lessons, and the pedagogical techniques to use while teaching them. This focus on what will be taught in the next lessons distinguishes the model’s professional
development from the traditional generic workshops that have failed to change teacher practices and student achievement (Killon, 1999; McLaughlin & Oberman, 1996). In later years, the focus shifts to deepening teacher content knowledge, increasing student-generated inquiries, and pedagogic challenges. At the same time, the basic professional development continues to be provided for new teachers in response to teacher mobility.

In-classroom support available on a weekly basis over the entire school year is provided by expert peer coaches familiar with the curriculum and middle grades’ pedagogy. Teachers and classes vary in their abilities and needs. Peer coaches see the teachers and classes in action and help teachers adapt the professional development and materials to the specific needs of their classes using such techniques as model teaching, co-teaching, and critical observation with confidential feedback. In this way, they help the teacher customize the science reform to their class and their own needs in a way that maintains its desired impact. For example, teachers may not be comfortable with use of hands-on activities done in cooperative groups because they themselves lack the skills to manage this type of work or their students cannot successfully work together. In response, a teacher may turn to demonstrating the activities, which solves their own classroom management concerns but frustrates the purpose of using a hands-on centered curriculum. A peer coach in the classroom sees why the teacher has turned to demonstrations. They can offer the teacher specific responses to the problem, such as explicit teaching of social skills students need to work in groups, strict student roles within groups that offer the teacher more control, or better teacher preparation and time management to avoid lags during class, which will allow the use of student activities. As both teacher and students become accustomed to hands-on instruction, the peer coach can advise the teacher on reducing the structure and increasing the role of students.

In-school leadership and supporting structures are needed to maintain the sustainability of the instructional changes. Peer coaches’ knowledge of the science faculty and the curriculum, and their ability to work with the school administration allows them help establish such structures as regular science faculty meetings, times for teachers to observe others’ teaching, and mentoring of new teachers. These structures allow teachers to support one another, share ways to improve instruction, and help induct new teachers. Such structures built into the school schedule (versus remaining informal) are easier to maintain and receive greater support from school administration. Peer coaches are in position to identify excellent teachers who can become the trainers for new science teachers. These teachers receive additional professional development in how to train new teachers, then act as co-trainers with the coach, and finally take the lead in training workshops.

**Matched Schools:** The study features 3 Philadelphia schools in which the TD model was implemented, which were matched with control schools. Treatment schools 1, 2, and 3 are briefly described below.

**School 1 –** School 1 had the weakest implementation for the cohort studied due to an initial lack of funds to purchase materials. In the first year, the program provided supporting materials and training through classroom visits and after-school trainings. FOSS and STC science materials were purchased first with grants form the Urban
Systemic Initiative and later using school funds. These were incorporated into the curriculum first in the fifth grade and moving up through the sixth and seventh grades over time, often too late to have a major effect on the relevant cohort and teacher in-class and after-school training were provided.

School 2 – School 2 had the strongest implementation for the cohort studied. After developing a school wide science curriculum, School 2 used school funds to purchase the science materials and supplemented these with others from the Franklin Institute science Museum. Additional materials for all grades were purchased with a grant from the Urban Systemic Initiative. With the provision of monthly professional development and in-class support, implementation was strong for the next 2 years of the study, especially for the lower grades. Seventh grade suffered from extreme science teacher turnover but the continued provision of the basic level of professional development maintained a strong implementation.

School 3 – had a medium level of implementation for the studied cohort, but these students received 1 less year of exposure to the treatment as they entered the school in sixth grade. In Year 1, the science faculty developed a standard curriculum and attended after-school and in-class professional development built around the science materials purchased by the school for sixth grade. The next year saw the purchase of materials for the seventh grade and the continuation of the same level of professional development leading to strong implementation in the sixth grade and medium implementation in the seventh grade.
Between January 28, 1989 and January 30, 1990, Professor David Brooks and one of four different high school teachers who had been involved in the production of the Doing Chemistry materials conducted 19 workshops for 206 high school teachers who would become Doing Chemistry lead teachers (Table 1). The workshops were held in 18 different states and at the ChemEd conference in Kingston, Canada. The lead teachers came from 46 states, the District of Columbia and Puerto Rico. In addition 28 observers attended the workshops. Each lead teacher who was trained in a workshop was given the Doing Chemistry videodiscs, a set of Macintosh Hypercard program stacks, and the 620 pages of written materials. As trained lead teachers, they were expected to use the Doing Chemistry materials to train other teachers to use more laboratory activities in their classrooms.

Lead Teachers
Twenty-four in-service elementary and middle school teachers (23 females and 1 male), representing five school districts, volunteered to be trained as project "lead teachers." The lead teachers ranged in teaching experience from 3 to 17 years and represented all grade levels, K-8. The incentives provided to the lead teachers to commit to the 3-year project were: (a) $450 stipend, eight graduate semester credits at 40% tuition reduction, and 100 hours of summer workshops during Year 1; (b) all-expenses-paid field trips to the Kansas Cosmosphere/Space Center Museum and Wolf-Creek Nuclear Power Station (Burlington, Kansas) during the first semester of the project; (c) stipends ranging from $190 to $550 and an opportunity to earn up to five graduate semester credits at 60% tuition reduction (depending on level of participation) during Year 2; (d) 27 hours of video-teleconferences and a total of $30,000 for classroom materials over 2 years to share ideas and experiences with other lead teachers in the region; (e) opportunities to lead regional workshops for extraproject teachers during the second summer of the project; and (f) all-expenses-paid trips to present materials and workshops developed at regional and national professional conferences during Year 3 of the project.

Workshop Participants
More than 235 in-service teachers attended at least one of four different workshops held at 13 sites provided by the lead teachers. These workshop participants represented teachers at all levels K-12. Approximately 161 (68%) of these workshop participants taught in grade levels K-6. Of the other 74 participants, 49 were secondary mathematics teachers.

Project Management
The project was overseen by a 10-member steering committee and managed by a leadership team of six individuals. This project leadership team included three university faculty members, a project accountant, a summer workshops manager, and a graduate research assistant. For each of the leadership team members, the time devoted to the project ranged significantly, depending on the semester and year of the project.

Method
Lead Teacher Empowerment
Using a guiding principle that permanent change comes from classroom teachers, 24 inservice teachers participated in 100 hours of workshops during the summer of 1995. The workshops emphasized using hands-on manipulatives for science and mathematics to bring about positive attitude changes toward using constructivist pedagogy. The topics for the workshops were selected by polling the participants as to what topics they perceived to be most needed by all inservice teachers in Kansas. An abbreviated list of
selected topics can be found in the appendix. This cadre of teacher-participants became the project's lead teachers. The workshop was led by the authors and two regionally recognized master teachers. Additionally, the workshop included two day-long field trips to enhance collegiality.

Following the initial summer leadership workshops, the lead teachers ordered a total of $20,000 in hands-on manipulatives and science equipment to determine "what works" in their classrooms. Lead teachers met after school twice each month during the school year via video-teleconferencing links to share ideas, results, and frustrations.

Teacher-led Workshops
During the summer of 1996, 13 summer workshops were delivered to 235 in-service teachers using the master teacher or key teacher method (Carpenter, Smith, Astwood, Wideman, & Ryan, 1993; Ross, 1990). The lead teachers created four distinct 1996 summer workshops: manipulative-based mathematics; scientific inquiry; integrated science/math; and advanced integrated science/math. The workshops adopted a consistent theme of "Teachers Teaching Teachers: What Works for Integrated Math and Science Instruction" and covered the topics listed in the appendix. The workshops were conducted by teams of two to six lead teachers daily. Lead teachers purchased an additional $10,000 in instructional materials to conduct the workshops. Each workshop was designed for 16 contact hours and one graduate semester credit (except for Integrated Science/Math, which was designed for 32 contact hours and two graduate semester hour credits). Advertisement and scheduling of the workshops was accomplished by the authors through school district visits, school building posters, and direct mailings.

As shown in the appendix, the lead teachers decided to provide workshop participants with a wide variety of activities through numerous examples. The general format was for lead teachers to lead the workshop participants through a 40-minute activity. Afterwards, the lead teachers would facilitate a 20-minute discussion among the workshop participants about how to best integrate the activities into local curricula and provide copies and descriptions of three to four supporting activities as examples. This process would be repeated four to six times each day.

For example, the manipulative-based mathematics workshop began with an introduction to geoboards and a challenge to make a variety of geometrical shapes with given constraints (e.g., create 10 polygons with an area of 3 square units). Then lead teachers asked workshop participants to create and share other tasks for students. Finally, the lead teachers would model "lesson debriefing" by providing a possible list of activities for students that workshop participants might like to try in their own classrooms. This discussion always included questions about what cross-curricular connections could be drawn from each activity and strategies to make the activity more integrated between science and mathematics. This general model was used for each of the topics shown in the appendix.
The past decade has witnessed considerable efforts to improve the quality of science instruction in America’s schools, with school reformers arguing that all students should do more intellectually rigorous science work. Raised expectations for students’ academic work have increased the expectations for teachers’ instructional practice, expectations that imply substantial changes for existing classroom pedagogy. National and state standards along with new assessment systems press teachers to revise their teaching. Because of the nature and magnitude of the reforms, most teachers struggle to understand their substance and their implications for practice (Cohen, 1988; EEPA, 1990; Schifter & Fosnot, 1993; Spillane, 1999). Transforming reformers’ proposals for instruction into sustained daily practice is difficult and depends largely on local circumstances, especially school conditions that support teacher learning (Newmann & Wehlage, 1995). The challenge of going to scale and to substance with recent science reforms also depends in important measure on the local school, especially the school’s resources for leading reform of science education. Absent the mobilization of these resources in the cause of science education, recent reforms are likely to have only marginal effects on instructional practice.

Yet it is part of the folklore in education circles that science education falls through the cracks in most elementary schools, failing to make it onto schools’ innovation agendas, let alone into most classrooms. In elementary schools science is largely a fringe subject, taken up when time allows, but mostly forgotten or treated intermittently and unsystematically (McCutcheon, 1980; Smith & Neale, 1991; Stake & Easley, 1978). Our research on urban school leadership for mathematics, science, and literacy supports these impressions—science tends to get short shrift. We suspect that science is devalued in urban elementary schools for two reasons. First, teachers often believe that children from low-income families, concentrated in urban school districts are incapable of handling instruction beyond basic skills (Ayon, 1981). Teachers commonly assume that these students need to master the basics—particularly mathematics and language-arts skills—before engaging in more intellectually challenging materials (Spillane, 2001). This view was pervasive among the teachers in the schools we studied. Their perspective was that a large percentage of their low-income, African American, and Latino and Latina students needed to hone their basic literacy and mathematics skills before engaging in more challenging work. Hence, mathematics and language arts occupy the bulk of the elementary school day. Second, recent policy initiatives that hold schools accountable for student performance in language arts and mathematics, especially common in large urban school districts, have accentuated the inattention to science instruction. Accountability measures create considerable instructional pressure for teachers in urban schools where the gap is great between performance goals and students’ actual performance. Bridging this gap in language arts and mathematics can exhaust schools’ resources, and subjects not targeted by accountability mechanisms, such as science fall through the cracks.
As one might expect, urban schools in our study worried less or not at all about those subjects for which no tangible rewards or sanctions existed under accountability regimes. As a result, elementary-school science teaching was left largely to teacher discretion and to resources outside the school that individual teachers might tap. Our goal in this article, however, is not to dwell on the unequal distribution of resources for leading reform across school subjects. Our central aim is to analyze the resources for leading innovation in urban elementary schools in order to understanding how resources are identified and activated in the cause of science education. More specifically, we examine how school leaders bring resources together to enhance science instruction when other subjects, by virtue of tradition and formal policy, command the bulk of the resources. We begin by outlining the theoretical frame for our research and describe our study of leadership for instruction in 13 Chicago elementary (K-8) schools. We then consider how the subject matters when it comes to resources for leading instruction in urban elementary schools by comparing resources for leadership in mathematics, science, and literacy in these schools. After describing the between-school variation in the resources for leading science education, we analyze a case of one urban elementary school that successfully identified and activated resources for leading change in science education.
This article highlights the boundary crossing and brokering work of two instructional coaches in one Washington State urban district. A distributed leadership frame helps foreground how the coaches, based in the central office, excised instructional leadership across the district. This inquiry contributes to emerging pictures of the kinds of roles that central-office leaders—in this case, those of instructional coaching—play in prompting and supporting system wide instructional improvement. Important implications for system wide reform efforts emerged, including issues about strategic communication opportunities afforded by boundary crossers in a system, as well as considerations about preparing and supporting those who assume brokering and boundary-crossing roles in a multilevel system.

Although coaching as a structure and support for education reform is becoming common in schools and districts, conceptions of coaching vary, including, for example, school-based math or literacy coaches, school change coaches, and systems coaches (Guiney, 2001; Neufeld & Roper, 2003; West & Staub, 2003). This article draws from a qualitative case study of two instructional coaches based in the central office of a midsize urban school district in Washington State. In this district, instructional coaching included content-specific work (e.g., helping teachers develop new strategies for literacy instruction) as well as duties associated with the work of school change coaches (e.g., supporting planning for school wide improvement). Unlike other models in which a coach resides in a single school, the two instructional coaches profiled in this article were based in the district central office and thus worked in several schools. Examining aspects of this centrally based coaching model allowed for a systems perspective, rather than a school perspective, of instructional leadership. The focus of the study was not the coaching activities performed by these two coaches but, rather, how their work can be understood as a brokering and boundary-crossing practice (Wenger, 1998) that connected--or did not connect--school and central-office instructional reform efforts. It was the ongoing movement between the levels of the school district-and the associated communication, translation, and brokering—that was the focus of this inquiry. This article suggests that these activities can be understood as a particular kind of instructional leadership practice that was exercised across the system. Informed by research on professional development and district roles in school reform (Fullan, 2001,2004; Hightower, 2002; Knapp, Copland, & Talbert, 2003; Neufeld & Roper, 2003), as well as by my own experience as a district instructional technology specialist, the following questions guided this inquiry:

- What does a centrally based coaching design mean for the way that coaches move between and among the central office, schools, and classrooms?
- How does a central-office affiliation influence how coaches are perceived and what they are able to do?
- How does a coach navigate the real or perceived boundaries of a multilevel district system?
In what ways do the presence and behavior of a coach affect relationships and communication among actors and levels of the system?

This investigation was designed to foreground the brokering roles that coaches assume as they move between and among levels in a complex urban school district; such framing allowed for a systems-level analysis of instructional coding as a district strategy for reform.

This article draws from and builds on research on leadership distribution (Spillane, 2006; Spillane, Halverson, & Diamond, 2001), the nature of brokering within an organization (Wenger, 1998), and central-office leaders' as consequential players in instructional reform (e.g., Elmore & Burney 1998; Hightower, Knapp, Marsh, & McLaughlin, 2002; Hubbard, Mehan, & Stein, 2006). Using a distributed leadership frame for understanding (Spillane, 2006; Spillane et al., 2001), this investigation contributes to a growing body of literature about the lands of roles that district leaders play in prompting and supporting system wide instructional improvement. In addition, the article highlights the dynamic nature of leadership distribution, given how these instructional coaches continually shifted roles between leader and follower as they moved between levels of the system.

After a short discussion of instructional coaching in the context of district reform efforts, I explore a conceptual framework that locates this instructional coaching model within the context of distributed leadership practice at two different levels those of the central office and the schools. Next, I provide a brief overview of the study design and district setting, and I explore three themes that emerged from the data: exercising instructional leadership for reform and instructional improvement; boundary crossing in a multilevel system; and communicating, carrying messages, and brokering among communities. Finally, I explore how findings from this study inform scholarship and practice related to instructional coaching and the exercise of instructional leadership at different levels of a district system.
This project was initiated by the Education Department of Western Australia in the aftermath of the MSE report, *Profiles of Student Achievement in Science in Western Australian Government Schools* (Education Department of Western Australia, 1994a). Under pressure to respond to the disappointing MSE results, the Western Australian Minister for Education announced the Science Project, a four-year initiative to improve the status and priority of science, provide curriculum materials and support professional development for teachers (Education Department of Western Australia, 1994a). The Science Project was managed by the office of the Superintendent (Science) and advised by a cross-sectoral committee including representatives from the Catholic Education Office, the independent sector, universities, the Science Teachers Association of Western Australia (STAWA) and the Scitech Discovery Centre. The overall goals of the Science Project were to:

1. provide all schools with access to exemplary curriculum materials;  
2. establish an effective, whole school curriculum in primary schools;  
3. establish science teaching methodology in primary and secondary schools consistent with identified best practice;  
4. provide access for teachers to update their knowledge of science and its role in society; and  
5. establish networks of curriculum leaders to provide ongoing support for teachers. (Education Department of Western Australia, 1995)

Several concurrent primary school projects were conducted under the umbrella of the Science Project. These included a joint project with STAWA to support *Primary Investigations* training, the Twelve Schools Project, an evaluation of primary science curriculum materials, and teacher access to science content upgrade courses. The major effort, however, was directed to the Primary Science Teacher-Leader Project which was steered by a committee of representatives from the Education Department, three Western Australian universities and the Scitech Discovery Centre. The project commenced in 1995 with 29 teacher-leaders, one from each of the geographically organised education districts in Western Australia. In 1996, a second teacher-leader was selected from each district. Where the 1995 leader did not continue for the second year, the district was offered two positions for the 1996 project. In each year several leaders were based in district offices while others were school-based. Five additional leaders were included in the 1996 project, each with specific expertise in one of the following areas: early childhood education, English as a second language, education support, Aboriginal education, and isolated and distant education.

In the initial year, the 29 teacher-leaders were involved in ten days training focusing on aspects of planning, teaching and assessment of primary science, identification of best practice, science content, examination of teaching resources and support materials, and ways of providing support for other teachers at the school and district level. The second
year of the project involved the ongoing training of the 1995 primary teacher-leaders and the training of the new primary teacher-leaders for 1996, a total of 65 participants in all. The 1995 teacher-leaders participated in a total of four days training in their second year and the 1996 teacher-leaders participated in a total of nine days training. The training was provided by a broad spectrum of science educators from three local universities, Scitech Discovery Centre, STAWA, the Education Department and industry. The purpose of the training for 1995 leaders in 1996 was to provide ongoing training in science content, teaching pedagogies, the use of outcomes statements and train-the-trainer skills to deliver professional development within their districts. The program aimed to provide training in:

1. effective implementation of whole school programs to suit the needs of individual schools;
2. best practice in the teaching and learning of science in primary schools;
3. the use of outcomes to monitor student achievement in science;
4. effective strategies to support primary school teachers in primary science; and
5. the integration of teaching and learning of science with other learning areas.

At the district level, primary teacher-leaders were asked to work with their district offices to plan and implement a science support program for local teachers. These local support programs were funded by the project, each district receiving A$5,000 in 1995 and between AS 12,000 and A$16,000 in 1996. The fourteen metropolitan districts each were made up of approximately 30 primary schools and the fifteen rural districts approximately 25 schools with primary-aged students. The rural districts generally consisted of a central town with one or more primary schools and several other primary schools in centres ranging from 20kin to several hundred kilometres away. The teacher leaders were required to submit a proposal for their local support program, including a budget, to the Superintendent (Science) for approval. The funding was used to pay for a variety of activities as will be discussed in the case studies later in the results section of this paper.
Two elementary teachers and their schools were randomly selected from a pool of 24 lead teachers from 12 schools participating at one of eight sites in a statewide reform project (See also Franklin, 1992, 1993; Miller, 1995; Nesbit & Wallace, 1994; Nesbit, Wallace, & Miller, 1995; Vesilind & Jones, 1993.)

The project sought to integrate school-based planning, leadership development, and peer training to improve elementary mathematics and science education. Two teachers from each school participated in a 3-week institute, 3 follow-up training days during the school year, and a 1-week institute during the second summer. One goal was that lead teachers would “work with their colleagues to implement plans for improving mathematics or science instruction at schools.” A second goal was for lead teachers to become “peer teachers” at their schools (Franklin, 1993). As researchers, we were not part of the project implementation.

When lead teachers joined the project, they were asked to work with their principals to administer an assessment instrument to all teachers in their schools and to use the results to develop a vision for their science or mathematics program. At both schools in this study, the school improvement plans were about science programs. After the school improvement plans were designed, lead teachers attended a 3-week summer institute at a nearby university. For both schools in this study, only one lead teacher participated fully in the summer institutes.

The regional institute attended by the teachers in this study focused on resources and materials for teaching, with some presentations about science content knowledge. Teachers also learned about staff development materials and workshops such as Project Learning Tree and LifeLab. Instructors hoped to build lead teachers’ confidence and enthusiasm through group activities and hands-on demonstrations. Instructors expressed concern about the teachers’ comfort level with content knowledge and said they did not want to threaten teachers with more science content than the teachers were ready for. One lead teacher told us that the main idea she got from one of the more didactic science content presentations was the insight that she herself does not learn by listening. She asked, “So how can I expect my students to learn that way if I can’t do it myself? They have to be active, just like me.”

Through voluntary sharing among teachers, issues of school culture emerged as part of the informal institute agenda. For example, both lead teachers in this study described to us their excitement about working as colleagues with their principal or assistant principal to draft the school improvement plans. When lead teachers shared news in the institutes and follow-up meetings, they frequently described evidence of their principals’ interest or lack of interest in the project. According to lead teachers, a most valued sign of principals’ support was the giving of extra planning time to lead teachers.
Although peer coaching was recommended by institute leaders as an effective tool for staff development, the lead teachers in this study neither received training in peer coaching nor perceived any expectations to use peer coaching. Rather, the lead teachers left the first institute with notebooks of resource information and plans for exemplary classroom activities, which they intended to use and share in their schools.
Abstract: The Oregon Mathematics Leadership Institute (OMLI) NSF-MSP project partners are Oregon State University, Portland State University, Teachers Development Group and ten Oregon school districts. The primary activities of the project were a sequence of three intensive three-week residential institutes emphasizing mathematics content knowledge for teaching, collegial leadership, and the building of professional learning communities. Teachers at all levels K-12 participated together in the mathematics content courses. By the conclusion of the third summer institute, teachers had shown significant improvements in mathematical content knowledge for teaching. Analysis of student achievement data in participating schools was initially inconclusive. However, once implementation fidelity traits were taken into account, a positive relationship between project participation and student achievement emerged. The degree to which schools implemented the practices promoted by the OMLI project is a significant positive predictor of student performance above and beyond what can be explained by the socioeconomic factor as indicated by the percent of students who qualify for free and reduced lunch program. This relationship is particularly acute at secondary levels, but additional factors appear to be at play at elementary grade levels.

Setting: OMLI is a partnership between Oregon State University, Portland State University, Teachers Development Group, and 10 Oregon school districts: Beaverton, Bend-LaPine, Crook County, Molalla River, North Clackamas, Redmond, Reynolds, Roseburg, South Lane, and Woodburn. These school districts include both rural and urban settings, a wide range of socio-economic student backgrounds, and one district with a majority of ELL students.

Intervention: The unit of participation in OMLI is a School Leadership Team, ideally consisting of two teachers and one school administrator, usually the principal of the school…Participating teachers attended 3-week residential summer institutes in three consecutive summers (2005, 2006, and 2007). The participating administrators attended the third week of each of the three summer institutes. These summer institutes included mathematics content coursework across six strands: numbers and operations, algebraic structures, measure and change, geometry, data analysis and probability, and discrete mathematics. The mathematics content coursework was complemented by leadership development coursework. Academic year activities facilitate the ongoing development of collaborative professional learning communities within each participating school. These activities will continue at least through the 2008-2009 academic year and are intended to promote and sustain systemic mathematics reform to increase student achievement in mathematics…

The typical schedule for the institute involved teachers attending two two-hour mathematics classes in the morning with a two-hour study session and a two-hour Collegial Leadership workshop in the afternoon. Approximately 60 teachers each were
enrolled in a “triad” of courses consisting of a pair of mathematics courses and the Collegial Leadership workshop. Hence, all 180 would have participated in all six mathematics content strands and three Collegial Leadership workshops by the conclusion of the third summer institute in summer 2007. The six mathematics content strands are paired as follows: 1) Numbers and Operations & Geometry; 2) Data and Chance & Discrete Mathematics; 3) Algebraic Structures & Measurement and Change.

Using the Conferences Board of the Mathematical Sciences recommendations for the preparation of teachers, OMLI mathematics instructors chose depth in a few “big idea” topics rather than attempting to address many topics. In each content course there was an explicit emphasis on student discourse and faculty were expected to model many of the pedagogical techniques used in K-12 classrooms that are the focus of the Collegial Leadership workshops in the afternoons.

During one of the afternoon periods, teachers participate in a facilitated “study hall” with mathematics content faculty available for assistance. During the other period, teachers participated in a Collegial Leadership workshop facilitated by staff from the Teachers Development Group….During the afternoons of the third week, principals had opportunities to work together in a team with the teachers from their schools to develop school action plans for professional development during the upcoming year.

During CLM activities, the Collegial Leadership team draws heavily on the latest nationally-recognized, evidence-based mathematics professional development and leadership development resources, such as: Designing Professional Development for Teachers of Science and Mathematics, Video Cases for Mathematics Professional Development, 6-10, Learning to Lead Mathematics Professional Development, Fostering Algebraic Thinking: A Guide for Teachers, Grades 6-10, Developing Mathematical Ideas, Children’s Mathematics: Cognitively Guided Instruction, and Lenses on Learning. Team members modeled and emphasized NCTM Standards-based “best” instructional practices and curricula and provide extensive instruction and mentoring to School Leadership Teams for effective job-embedded, practice-based professional learning (e.g., lesson study, protocol-based collegial observations and examinations of student work, case discussions and development, book studies, etc.).

Site visits to participating OMLI schools involved a minimum of a half-day site visit per school, with four site visits each year per school. These site visits are designed to:

1. Support School Leadership Teams for implementation of their Collegial Leadership Action plans, which were crafted by the teams during the 2007 Summer Institute to initiate and sustain school-based collaborative professional learning communities whose work centers on mathematics content, learning, teaching, and leadership.

2. Support continued learning by the OMLI participants and their school colleagues through first-hand experiences with practice-based professional learning facilitated by OMLI faculty. Specific site visit activities designed to support learning for effective lesson design and implementation:
• Data snaps (classroom walk-throughs) to gather data as context for professional dialogue and making inferences regarding what typifies mathematical discourse across the school
• Case discussions (video and print)
• Extended classroom observations and inference dialogue based on Teachers Development Group’s Student Discourse Observation Protocol and Collaborative Lesson Planning (designed to support teachers in moving classroom discourse along a continuum from a focus on procedures and facts to a focus on justification and generalization)
• Consultation regarding implementation of school mathematics curriculum materials
• Co-facilitation (with OMLI participants) of school-based professional development and district [sic]
• Coaching OMLI participants in leading the district site visit meetings
• Facilitating and/or coaching the facilitation of the examination of student work by OMLI participants and/or their building colleagues

In addition to site visits, OMLI site visit faculty members facilitate four half-day district meetings throughout the academic year in each district. During these meetings all participating OMLI teachers and administrators from a district come together to share their successes and challenges, plan for district-wide expansion of OMLI, and to continue learning together by examining student work, discussing professional readings, collaborative lesson planning, analyzing and enhancing mathematical tasks, and/or other activities such as those in the bulleted list above….

School Leadership Teams were expected to actively increase the quantity and quality of school-based collegial inquiry and discourse about mathematical and pedagogical content by planning and facilitating regular academic year meetings of building colleagues, using and facilitating practice-based professional development activities such as classroom observations and collaborative examinations of student work.

Research Questions:

1. Has the OMLI professional development prepared the teacher leaders for their leadership role in terms of mathematics content knowledge for teaching?
2. Has the OMLI project increased student achievement (as indicated by the percentage of students who demonstrate proficiency on the Oregon State Mathematics Assessment for grades 3, 5, 8, and 10) in all participating K-12 schools?

Implementation scales – RMC Research analyzed data from the 13-trait rubric and identified 2 sets of 5 of the 13 traits that were highly correlated to student achievement on the 2007 state assessment. One set was correlated to student achievement at the elementary level and the other set was correlated to student achievement at the secondary level.
Secondary Implementation Scale – Grades 8 & 10: The following traits made up the secondary implementation scale (SIS) and are correlated to student achievement in secondary schools. RMC Research used the ratings for each school (on the 13-trait rubric they developed) to calculate the elementary and secondary implementation scale score for each OMLI school.

- Quality of the school action plan for improving mathematics teaching and learning developed by the school leadership team during the summer institutes;
- How well the school leadership team implemented the action plan;
- The degree to which the school leadership team conducted regular school-based professional development with the other mathematics teachers in their school;
- The degree to which the school-based professional development reached all or a critical mass of mathematics teachers in the school; and
- The degree to which the professional development utilized well-defined professional learning tasks and protocols developed by project staff and modeled during summer institutes

Elementary Implementation Scale – Grades 3 & 5: The following traits make up the elementary implementation scale (EIS) and were correlated to student achievement in elementary schools (Grades 3 and 5):

- Leadership qualities of the teachers on the school leadership team;
- Whether the school leadership team had a second teacher participating;
- The degree to which the school and district policies and practices are supportive of the work of the school leadership team;
- The degree to which mathematics is a priority for the school; and
- The degree to which the professional development utilized well-defined professional learning tasks and protocols developed by project staff and modeled during the summer institutes
This article examines the results of a teacher leader training model entitled Project Achieve, which focuses on improving middle level teaching performance and student achievement. The teacher leader model was implemented at an urban middle school during the 2005-2006 academic year. The premise of Project Achieve is that when teachers are given opportunities to improve their teaching practice through on-site, personalized, professional development by teacher leaders, increased student learning follows naturally.

To evaluate the extent to which the teacher leader model was successful in increasing instructional competence, questionnaire and observation protocols were developed based on the Marzano’s (1992) Dimensions of Learning Model. The pre-and post-questionnaire responses measured teachers’ beliefs and self-reported use of Marzano’s strategies over time. Pre-, mid-, and post-observations were conducted by the TLs after being trained to use the instrument and an acceptable inter-observer reliability was established ($r = .83$). The observation data measured the extent to which teachers were actively using the teaching strategies. Student achievement was measured using both curriculum-based and standardized test results against data from a comparison middle school in the same district with similar demographics and a traditional model of professional development.