

Interventions/Outcomes Involving Teacher Leaders' Preparation: Developing Knowledge and Skills for Teacher Leadership

Excerpted from Blank, R.K., Smithson, J., Porter, A., Nunnaley, D., & Osthoff, E. (2006). Improving Instruction through school wide professional development: Effects of the Data-on-Enacted-Curriculum Model. *ERS Spectrum Journal of Research and Information*, 24(2), Spring 2006.

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 spent on 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 on 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.

Excerpted from Blasie, C. & Butler-Kahle, J. (2009). The Penn Science Teacher Institute: A proven model. *The Journal of Mathematics and Science: Collaborative Explorations*, 11, 41-55.

The University of Pennsylvania's Master of Chemistry Education (MCE) program graduated five cohorts of approximately twenty teachers between 2002 and 2006. One year after the teachers in the last cohort earned their degrees, the Penn Science Teacher Institute (Penn STI) initiated a follow-up study to ascertain if the goals of the MCE program had been sustained. For example, were the teachers incorporating updated content knowledge into their lessons and were their students learning more chemistry? A total of seventy-four of the eighty-two graduates participated in some aspect of this study. Because baseline data were not available for the MCE teachers and their students, baseline data from a comparable group of chemistry teachers enrolled in the first cohort of the Penn STI program and their students were used in some analyses. Among other findings, the data indicate that MCE met its goals: 1) to improve the chemistry content knowledge of its teacher participants; 2) to increase the use of research-based instruction in their classrooms; and, 3) to improve student achievement in chemistry (students of MCE graduates scored significantly higher than the comparison group).

Excerpted from Brown, C.J., Fouts, J.T., & Rojan, A. (2001). *Teacher Leadership Project 2001: Evaluation report*. Fouts & Associates, L.L.C. (ERIC document 475748

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 School Kit. 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.

Excerpted from Copeland, L.L. & Gray, R.C. (2002). Developing Maryland's technology education leaders for the 21st century: Technology Education Leadership Project (TELP). *Journal of Industrial Teacher Education*, 39(3), 104-121.

The Technology Education Leadership Project (TELP) is a statewide project designed to enable technology education teachers to more effectively deliver instruction that results in students achieving the technology outcomes identified by the State of Maryland. TELP addressed a long-term goal of Maryland educators to enhance technology literacy for all students by integrating the study of mathematics, science, and technology as a required component of the educational program.

The process for identifying the need for the Technology Education Leadership Project included the results from the 1993 to 1997 surveys of Maryland's technology education supervisors. As a follow-up to those surveys, the TELP evaluator developed another survey to determine the effectiveness of the project and to identify future needs as rated by technology education supervisors.

One of the primary objectives of TELP was to provide in-service professional training and teacher enhancement for more than 400 Maryland technology education teachers. Areas of instructional focus included the Core Technologies, teaching/learning strategies, and leadership. Ninety technology education teachers were selected from school districts across Maryland to become Teacher Leaders. The Teacher Leaders received intensive training and would later deliver local in-service to other teachers. The project involved five components: (a) summer institutes, (b) local planning teams, (c) weekend institutes, (d) local in-service training, and (e) evaluation and follow-up. Over a three-year period, Teacher Leaders participated in four weeks of summer institutes and twelve weekend leadership sessions during each school year. During year three, Teacher Leaders, with the assistance of administrators, planned and delivered ten days of in-service training for teachers in their school systems.

Teacher Leaders' Intervention: Over a three-year period, Teacher Leaders participated in four weeks of summer institutes and twelve weekend leadership sessions during the school year. Teacher Leaders received 60 clock-hours of instruction on the Core Technologies [(a) mechanical technology, (b) electrical technology, (c) electronic technology, (d) structural technology, (e) fluid technology, (f) optical technology, (g) thermal technology, (h) biotechnology, and (i) materials technology], 43 hours of instruction on teaching/learning strategies, 15 hours of instruction on information systems, and 36 hours of instruction on facilitative leadership. Participants could earn up to six college credits for completing all phases of the Project.

Teachers' Intervention: With the assistance of administrators, Teacher Leaders planned and delivered ten days of in-service training for teachers in their school systems. Teacher Leaders were responsible for conducting ten days of local in-service training for technology teachers in their districts. Each school district established a Local Planning Team to plan and deliver 60 hours of in-service to technology teachers. Recruitment difficulties at the local level, however, resulted in a participation rate that was far below

the number projected in the initial proposal, which anticipated 25 teachers from each larger district and half that number from smaller districts.

An experienced external evaluator coordinated all aspects of the project evaluation, including gathering formative and summative data. The evaluator's first task was to develop a Change Agent Survey, which was completed by each Teacher Leader during the first three months of the project. This survey established baseline data on all Teacher Leaders to determine their level of understanding and current use of the Core Technologies and teaching/learning strategies. It also addressed the leadership activities of the Project participants. Responses on this survey have been compared with responses on an identical survey given near the end of the project. The follow-up survey provided data on the Project's impact on teacher knowledge and changes in their instructional delivery. Surveys were mailed to 79 Teacher Leaders, with 57 returned for a total response rate of 72% for Change Agent Survey 2. Teacher Leaders were also required to evaluate the instruction and content delivery at the conclusion of each weekend and summer institute. This formative data was used to improve future activities.

Excerpted from Fortner, R.W., & Boyd, S. (1995). *Infusing earth systems concepts throughout the curriculum*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, CA.

In 1990 the National Science Foundation funded a three-year project entitled “Programs for Leadership in Earth Systems Education,” with the acronym of 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 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 (Table1). The administrators and college liaisons for those 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 advance questions was critical to this effort. Those who believe in ESE as a model for

curriculum structure are accustomed to thinking about classroom subject matter as being selected in answer to questions. If there is no question to be answered by an activity, why do it? To construct a good question, 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 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 the 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 product of PLESE that could become the beginning of curriculum restructure for teachers.

Excerpted from Fretchling, J., Katzenmeyer, C. (2001). Findings from the Multiagency study of teacher enhancement programs. In C.R. Nesbit, J.D. Wallace, D.K. Pugalee, A.S. Miller, & W.J. DiBiase (Eds.), *Developing teacher leaders: Professional development in science and mathematics*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Working through DEWG, six agencies initiated a study of professional development programs: the Departments of Energy (DOE), Education (ED), and Health and Human Services (HHS), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Smithsonian Institution. The work was coordinated by NSF and carried out by three independent research firms—Westat, SRI International, and the National Center for Improving Science Education. In the long term, the evaluation and other efforts of the DEWG were designed to meet two basic goals:

- Identify those government-supported professional development programs in science, mathematics, and technology that are most effectively implementing and encouraging “best practice,” and
- Assessing the extent to which these programs are contributing to the national effort to improve science education in the schools.

More immediately, this evaluation was designed to document the teaching practices promoted in the selected professional development programs believed to represent best practice in science education at the time of study initiation. The study examined the impact of these programs on teachers and their teaching, assessed the extent to which dissemination took place, and determined participant satisfaction with the programs and their outcomes. In addition, the study tried to identify the contextual factors that affect a teacher’s ability to apply new learning and use new approaches in the classroom setting. Based on an extensive review of the professional development literature available in 1994, best practice was defined in terms of four elements:

- An instructional approach that emphasizes hands-on/minds-on activities;
- A standards-based approach that aligns curriculum, instruction and assessment with local, state, or national standards or frameworks;
- Development activities that extend over time, including follow up when participants return to their schools; and
- Direct involvement of participants in the scientific process.

Using these and other selection criteria, program officers from each of the six agencies nominated professional development programs they considered successful in delivering professional development in science teaching. Additional considerations governing selection were 1) stability; 2) inclusion of teachers who themselves were from populations traditionally underrepresented in science or who work with significant numbers of students from those underrepresented groups; and 3) inclusion of programs that were carried out within a systemic reform context.

Excerpted from Freeman, J. A., Pounders, M., & Teddlie, C. (1994). *Evaluation of a summer science institute for elementary teachers*. Paper presented at the annual meeting of the Association of Louisiana Evaluators, New Orleans, LA.

The 34 Science Mentors met on a college campus for a three week Summer Program beginning July 12, 1993. Physical science content covered in the Summer 1993 Program centered on four topics: Magnets and Magnetism, Sound, Color and Light, and Matter and Its Changes.

During the three week course, the Science Mentors were taught physical science content using the same strategies and techniques that they were expected to use in their classrooms during the 1993-94 school year. The inquiry-based lessons were designed to feature hands-on activities, open-ended discussions and opportunities for independent investigation (LPSS, 1992).

The physical science content course was taught by a trainer from the American Institute of Physics and utilized materials from the Evelyn J. Daniel Educational Foundation. The Summer 1993 Program included having the Science Mentors work with a student population of 32 children from 16 participating schools in classroom settings on the college campus. Seminar topics for the Summer 1993 Program included assessment strategies, classroom management, computers in the classroom, an integrated mathematics curriculum and relevant special education topics. The sessions were taught by recognized experts on the discussion topics and by LPS staff members. The Science Mentors were broken out into two groups to attend the seminars: kindergarten and first grade teachers in one group, second and third grade teachers in another group.

Excerpted from Hofstein, A., Carmeli, M., & Shore, R. (2004). The professional development of high school chemistry coordinators. *Journal of Science Teacher Education*, 15(1), p3-24

In the Israeli education system, each school has a coordinating teacher for each of the disciplines. A program that was designed for the professional development of coordinating chemistry teachers was held during the academic year 1998-1999 at the National Center for Chemistry Teachers. Twenty-one teachers from all over the country, representing different types of high schools in Israel, participated in a weekly, full-day meeting for a total of 224 hours. Selection criteria for participation in the program were as follows:

- Teachers who currently function as coordinators or are due to become coordinators in the future
- Teacher with at least 5 years' experience as high school chemistry teachers (10th-12th grades) including experience in preparing students for matriculation examinations (final examinations set centrally by the Ministry of Education, Culture, and Sport), and who have reputations as successful teachers.
- Previous participation in at least five in-service professional activities. These are usually week-long, summer programs provided for chemistry teachers, mainly designed to introduce the teachers to the content and pedagogy of new textbooks, new curricula, or new programs.
- A recommendation provided by regional tutors or the school principal as being creative and open to curricular changes.

The Development of Content Knowledge

This part of the program was intended to update and enrich the potential coordinators with scientific chemistry content. It was based on Kempa's (1983) claim that the future development of teaching and learning materials in chemistry should include the following six dimensions: the conceptual structure of chemistry, the processes of chemistry, the technological manifestations of chemistry, chemistry as a "personally relevant" subject, the cultural aspects of chemistry, and the societal implications of chemistry. More specifically, it was suggested that, in the teaching and learning of chemistry, students should be exposed to recent investigations, namely, the frontiers of chemistry.

The Development of Pedagogical Content Knowledge

In the program, the participants were taught different instructional techniques to enhance their ability to vary the classroom-learning environment. Among the methods used were cooperative learning techniques, inquiry learning in the classroom and in the laboratory, simulations, field trips to research laboratories and various chemical industries, critical reading of scientific articles, questioning techniques, and students' miniprojects. To implement these novel methods requires management skills, flexibility, and the ability to devise an appropriate response to specific school characteristics, teaching goals, and various student populations.

The Development of Leadership Skills

In this phase of the program, the participants were also involved in programs for the development of decision-making ability, team-building and management, resolving conflicts, problem solving, and better social understanding,. Another aspect that was dealt with in the program was the need to maintain relationship with other managerial function personnel in school, as well as with higher authorities outside school.

During the program, with the help, guidance, and support of instructors and peers, the participants were given opportunities to try in their schools the new ideas discussed in the program and, consequently, to reflect on their fieldwork, provide evidence on what was done, and obtain feedback from their peers in the program.

Instrumentation

The data on teachers' perceptions and beliefs was obtained using both quantitative and qualitative measures. These were gathered at various stages of the program and a year after its termination.

Preprogram Questionnaire. This questionnaire was administered at the beginning of the program. In the first part teachers were asked to report on the extent to which they are involved in different aspects of high school chemistry instruction. This was a Likert-type scale containing 19 items. The second part was an open-ended-type questionnaire in which the teachers were asked to report on their expectations from the program.

Midterm Questionnaire. This questionnaire was administered in the middle of the program. Its aim was to obtain the participants' opinions regarding the contributions of the program, and the pedagogical changes that the teachers had introduced thus far in their daily functioning as coordinators and as classroom teachers. The questions were open-ended.

End-of-Year Questionnaire. The first part of the questionnaire was a repetition of the preprogram questionnaire. The second part probed the teachers' perceptions regarding changes they made in their schools and in their classrooms. The open-ended questions focused primarily on whether they felt that their expectations from the program had been fulfilled.

Follow-Up Questionnaire. This questionnaire was administered to the program participants 18 months after the end of the program. The participants were asked to describe the ways in which they deal with different aspects of the coordinator's role and to reflect on the effect the various activities they experienced in the program had on their daily functioning as a coordinator and classroom chemistry teachers. All questions were open-ended.

Teachers' Tasks and Activities in Schools. Information on the teachers' activities and assignments was also gathered through report they had presented throughout the program.

**Excerpted from Johanson, G., Martin, R., Gips, C., Beach, B., & Green, S. (1996).
The Evaluation of the Lead Teacher Project. Paper Presented at the annual
meeting of the American Educational Research Association, New York, NY.**

The Lead Teacher Project at Ohio University included 84 teachers participants who represented 42 schools from 13 school districts in Appalachian, Ohio. The project was designated to enhance the teaching and learning of science and mathematics at the elementary school level by helping the teacher participants develop skills, knowledge, attitudes, and most importantly leadership capabilities. The project founded by federal, state, local sources, used the resources of a range of experts at Ohio University in working partnerships for teacher training. The evaluation of the project was, in many ways as diverse as the project itself. It was first necessary to evaluate the effectiveness of the teacher- education courses. This was done through a course evaluation questionnaire, weekly surveys, and informal discussions. Some analysis used the teacher as point of analyses and others used the teacher's student as point of analysis. Student achievement was measured through the California Achievement Test, a process skills instrument created for the evaluation, and a curriculum standards survey for mathematics and science were recorded by a project-developed instrument. Growth in teacher leadership skills was accessed through still another project-developed instrument. In general, the project was evaluated with respect to student performance, teacher performance, school building changes, and leadership. These measurements demonstrate the effectiveness of the project. (SLD)

Excerpted from Kourey-Bowers, C.; Dinko, R.L., & Hart, R.G. (2005). Influence of a shared leadership model in creating a school culture of inquiry and collegiality. *Journal of Research in Science Teaching*, 42(1), 3-24.

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 $\frac{1}{2}$ 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.

Excerpted from Kimble, L.L., Yager, R.E., & Stuart, O.Y. (2006). Success of a professional-development model in assisting teachers to change their teaching to match the more emphasis conditions urged in the National Education Standards. *Journal of Science Teacher Education*, 17(3), 309-322.

Lead teachers were a major part of a staff-development program first offered in 1983 for science teachers in Iowa. Later, the National Science Teachers Association (NSTA) reform project called Scope, Sequence, and Coordination (SS&C) involved 20 school districts and worked annually with new teachers involved during the 7-year funding period, 1990-1997. Eight lead teachers, who provided assistance to staff teams, were studied in 1998 and 2000 to determine how their teaching practices changed during the 3 years following funding. The results indicated that the eight teachers have continued to grow in terms of constructivist strategies beyond the funding period and in ways illustrating that the kind of teaching advocated by the National Science Foundation Standards (National Research Council, 1996).

This study provides a clear picture of the lasting effects that Iowa reform efforts have had on a core group of teachers who were involved since the inception of the programs. The study was concerned with the teaching practices of eight of the participants who were active as lead teachers in the two Iowa programs that attracted national attention. Data were collected for 3 years after the NSF funding was curtailed. This study provided means for studying whether or not these teachers continued to expand and improve their implementation skills related to the project, including the teaching strategies and corresponding philosophies in their own classroom, without the continuing support provided by the NSF and state and local industries, nor any direct support from the project leaders from the University of Iowa.

The Iowa Chautauqua Program (ICP) was one of 17 original state projects funded by NSF in 1983 and coordinated nationally by the National Science Teachers Association. Iowa Chautauqua was conceived as a year-long effort (later, 3 years) that consisted of the following features:

1. A leadership conference for lead teachers, scientists, and associated staff operating in 3-5 instructional sites for a given year.
2. Three-week summer workshops dealing with new materials and plans for the use of sample modules by the pilot teachers when schools opened in the fall.
3. Teaching a 5- to 10-day mini module with student input in the areas planned during the summer.
4. A 3-day short course in early October to discuss the trial use of the mini module tried and to outline full modules and needed assessments to determine the effectiveness of the use of the new materials and approaches with students.
5. Two meetings in each district to discuss and monitor the pilot efforts with the material of each project headed by area education agency consultants and the central staff.
6. Weekly meetings in each building to compare successes and to report and discuss with other teachers not involved in the pilot (often shared via Internet access and the Iowa Communication Network fiber-optics connections across the state).

7. A second 3-day short course in April to amass assessment data and to share experiences with the 4- to 9-week pilot efforts; identification of specific leadership teams of teachers; and enlarge the pilot effort for the next school year (as each district moved to local adoption and perhaps as a partner in a local systemic change project).
8. Assembling assessment data for end-of-year reports and outline possible publications; selecting new leaders for future leadership responsibilities at new sites.

Iowa SS&C was funded in 1990 as a major grant (more than \$8 million in a 7-year period) to assist 20 Iowa schools where lead teachers from Iowa Chautauqua, their administrators, parents, and boards of education had requested that the changes developed by some teachers and used in some classrooms would become the norm for the science program across grades 6-12 in the entire district. This meant that the staff-development effort was to involve all science teachers in the 20 districts in all secondary schools, grades 6-12. Unfortunately, funding was curtailed in 1997, with efforts focusing only on grades 6-10 during the 7 years of funding for SS&C.

Excerpted from Madsen, A.L., Gallagher, J.J., & Lanier, P.E. (1991). *A new professional role for junior high school science and mathematics teachers*. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

The Science and Mathematics Support Teacher Program in The Toledo Public Schools is a collaborative project of the Department of Teacher Education and the Institute for Research on Teaching (IRT) of the College of Education at Michigan State University (MSU), the American Federation of Teachers (AFT), and the Toledo Public Schools (TPS).

The goals of this program are to increase teachers' science and mathematical knowledge, improve instructional practices, and prepare teachers to conduct staff development activities in their schools with their colleagues. It requires a new staff development model containing the components of three other staff development models, these are the: Developmental Model, Linking-Agent Model, and the Peer-Coaching Model. The Developmental Model as described in the works of Knowles (1984), Oja (1980), Glassberg & Oja (1981), Andrews, Houston, & Bryant (1981), and Tallerico (1987) includes four components necessary for this program: The first, that inservice programs contain concrete experience followed by reflective periods for assimilation of new learnings; second, that participants need continuous support and advising; third, that participants need to be encouraged to assume more responsibilities and more complex roles in the program; and finally, that longitudinal support needs to be provided during the period when new techniques are being practiced. The Developmental Model supports and encourages the mentor teachers as they develop new curricula and implement instructional changes.

The Linking-Agent Model developed through the works of Carlson (1965), Havelock (1967), Howsam (1967), Seiber, Louis, & Metzger (1972), and Caruso (1985) uses a person designated as a change-agent whose responsibility it is to institute specific curricular practices in their schools and with their colleagues. This model is useful for the mentor teachers as they work in their schools with their colleagues.

The Peer-Coaching Model developed by Showers (1983, 1985) AND Joyce & Showers (1988) is a special application of the Linking-Agent Model utilizing teachers trained in particular instructional techniques to act as coaches for their colleagues. This model is useful for two phases of the proposed program—when the Science and Mathematics Support Teacher pair work to implement instructional changes in their schools and when they support their department colleagues who will be in turn implementing curricular and instructional changes.

Features of these staff developmental models have been included in the Science and Mathematics Support Teacher Program and have as their goals the improvement of science and mathematics teaching and learning.

The program aims at implementing and studying this new professional role for science and mathematics teachers. This new role develops teachers as leaders in instructional improvement and change in the structure of schools. The innovative features of the model being piloted in Toledo include: 1) Collaboration of school personnel, union officials and university-based researchers in the development and evaluation of the model. 2) Grounding of the model upon results, conclusions and implications of extensive research on teaching including studies of actual classroom actions. 3) Establishing a new professional role in schools and preparing a cadre of junior high school science and mathematics teachers to work in their schools in that new role as exemplary practitioners and leaders in professional development activities with their colleagues. 4) Producing a framework for both introducing and implementing concepts and structures for improving classroom actions in specific subject areas.

The overarching goal of the project is to improve the opportunities of students' access to understanding of science and mathematics. The means of attaining this goal are: a) implementing instructional changes of the individual teachers; and, b) creating collegial working relationships among the school's science and mathematics faculties that support instructional improvement changes, experimentation, reflection and peer interaction in and out of the classroom.

During the fall of 1987, eight teachers were selected by their peers and administrators, one in science and one in mathematics from each of four Toledo junior high schools. From February to August 1988, these teachers were provided with over sixty hours of intensive preparation that included: a) Updating their knowledge about current research on teaching and learning science and mathematics; and b) Providing background and guided practice in working with professional peers in supportive role.

Excerpted from McGatha, M., Bush, W.S., & Thorn, D. (2005). *Becoming a leader in mathematics: A study of leaders' professional development experiences, awareness, beliefs, and attitudes*, Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics, Working Paper No. 26.

This study describes (a) potential mathematics education leaders' professional development experiences, awareness, beliefs, and attitudes and (b) the subsequent changes in these constructs as they participated in a leadership development program. The context of the professional development was a three-week institute and a year-long follow-up. The participants were 37 K-12 teachers and administrators and post-secondary faculty from schools, colleges, and universities in the Appalachian areas of Kentucky, Tennessee, West Virginia, and Ohio. To describe leaders' professional development experiences, awareness, beliefs, and attitudes, researchers developed a questionnaire that contained both Likert-scaled and open-response items. Participants completed the inventory three times over the course of the program. To determine if statistical significance could be associated to the overall means of the three data collections, researchers performed a Mauchly's test of Sphericity and a post hoc Sphericity Assumed or Greenhouse-Geisser analysis. In cases of statistical significance, researchers conducted a Pairwise Comparison analyses to determine the exact location of the significance. The analyses showed statistically significant changes in leaders' experiences, awareness, and attitudes.

Summer ALI

The ALI was conducted weekdays from July 6 through July 25, and all leaders were housed in two fraternity houses at the university. All sessions were held in a large meeting room of one of the houses. Sessions were conducted from 9:00 a.m. to 11:30 a.m. and from 1:00 p.m. to 5:00 p.m. During the evenings, planned and spontaneous informational and social activities were conducted. The ALI used national and local experts to address key issues in mathematics education, leadership, and professional development.

The first eight days of the ALI were devoted to building the leaders' knowledge base about mathematics standards-based teaching, curricula, assessment, and programs in general. Leaders analyzed and reflected on mathematics teaching practices through video cases. Representatives from three NSF-funded curriculum centers had leaders analyze NSF-funded mathematics curriculum materials. Leaders also learned about effective classroom assessment practices in mathematics and about a tool to conduct comprehensive evaluations of mathematics programs. Finally, they learned and discussed how being situated in a rural context might affect mathematics teaching and learning.

The last seven days of the ALI focused on building the leaders' knowledge of professional development and leadership skills. Leaders were introduced to a variety of goals and approaches to professional development in mathematics and discussed how to plan effective professional development. Leaders viewed video cases of professional development activities to help them analyze professional development practices and solve

problems that could arise in future experiences. Through a variety of activities, leaders reflected on their strengths and weaknesses as professional development providers. Finally, leaders learned strategies for addressing critics of the current reform movement in mathematics.

Professional development projects and mentors

During the subsequent year each leader was expected to conduct professional development the sending school or district. Participants could apply for mini-grants for up to \$5,000 to carry out the plans. To receive the grants, leaders had to collaboratively develop a professional development plan with a group of teachers, administrators, or college faculty in their locale and submit the plan for review and approval by ACCLAIM staff. Leaders were given until late October to meet with local educators and submit a professional development plan. The plans were then reviewed by ACCLAIM staff, and those plans that were deemed unsatisfactory or lacking were sent back to leaders for further revision.

Two of the 31 plans submitted were approved in this initial review. Eventually 31 plans were approved by ACCLAIM staff by December 1.

Leaders were assigned local mentors who had considerable experience in developing and conducting professional development in mathematics education. The mentors attended a one-day orientation and workshop, at which ACCLAIM staff provided information about their responsibilities. The mentors' responsibilities included providing emotional and professional support, helping leaders develop their professional development plans, and working with leaders to solve implementation problems. Against that background, mentors were required to have at least three personal visits with each of their leaders, attend at least one ALI follow-up meeting, and maintain regular email contact with their leaders. At the end of the year mentors were also asked to complete a questionnaire describing the strengths and weaknesses of each leader assigned to them.

Follow-up meetings

Since most of the initial professional development plans required revision, the November follow-up meeting was devoted primarily to helping leaders revise their plans. Staff discussed and gave examples of each component of the plan and provided an overview of evaluation strategies. The two-day March 2004 follow-up meeting was devoted to discussing issues and addressing problems that arose during leaders' professional development projects. Staff and mentors met with leaders in small groups to discuss successes, barriers, and concerns regarding their professional development activities.

The June 2004 follow-up meeting centered on reporting and discussing successes and challenges in the leaders' local professional development projects. ACCLAIM staff presented information about (a) teachers' stages of growth as defined in the Concerns Based Adoption Model (CBAM) (Hord, Rutherford, Huling-Austin, & Hall, 1987) and (b) strategies for connecting mathematics to their communities through place-based activities (Raymer, 2001). At this meeting, staff informed leaders that ACCLAIM had agreed to provide additional mini-grants up to \$20,000 to conduct local professional

development. To receive these funds, however, two or more leaders had to work collaboratively across multiple school districts. Leaders would have to meet with local district personnel and submit a professional development plan as before. Two of these projects were funded for the 2004 school year.

Excerpted from Miller, A.S., Wallace, J.D., DiBiase, W.J., & Nesbit, C.R. (1999). *Pebbles in the ocean or fountains of change? New insights on professional development: Examining the links—Professional development, teacher leaders, and school change*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Boston, MA.

This study provides a holistic analysis (Patton, 1990, p. 49) of a long term, large scale science and mathematics professional development project which was conducted by the Mathematics and Science Education Network (MSEN) of the University of North Carolina (Franklin, 1993) from 1990-1993. The project, which was funded by a three year grant from the U.S. Department of Education, Dwight D. Eisenhower mathematics and Science Education Programs, Fund for the Improvement and Reform of Schools and Teaching (FIRST), was composed of 15 two year professional development programs held at 8 university sites over a 3 year period (one university site did not participate in the first year of the project). Each university site recruited schools to participate with priority given to the schools which met one or more of the following criteria: minority population greater than the North Carolina average of 33%, a high percentage of students in the federal lunch program, or location in a small town (less than 5,000) or rural area. Of the 183 participating schools, 21% met all three criteria, 56% met two criteria, and 20% met one of the criteria (Franklin, 1993, p.5). The schools were recruited in a variety of ways by each university sites, with approximately 12 schools participating in each of the 15 professional development programs. There were 88 schools that participated in the first year of the project and 95 schools during the second year. The majority (55%) of the schools had a student enrollment in the medium range of 250-500 students (p.5). There were 45 schools (25%) with a minority population of less than 15%, 41 schools with a minority population of 15-33%, 47 schools with a minority population of 34-50%, 36 schools with a minority range of 51-75%, and 14 schools with greater than 75% minority population.

There were 354 lead teachers who began the project and demographic data was available for 349 (Franklin, 1993). Most of the lead teachers were female (94%) and 80% of the lead teachers were white, 17% African-American, and 3% other. The educational level included 67% with a Bachelor's degree, 31% with a Master's degree and 2% other. Sixtyone percent of the lead teachers taught in grades 3-6, with 33% in grades K-2, and 6% in other grades or areas. The average length of experience for the lead teachers was 11 years with a range of one to 30 years. Most teachers had majored in elementary or intermediate education in college with only 8% majoring in either mathematics or science. The lead teachers and the other teachers in their schools were similar with respect to gender, ethnicity, and educational level. One difference between the two groups was that other teachers included 46% who taught in grades K-2.

This project was designed to help improve science and mathematics teaching in North Carolina elementary schools. The overall project plan included site-based planning based on needs assessments, professional development that was responsive to the needs of the lead teachers at that site and reflected national standards, involvement of the lead teachers

and principals in the change process, and “fostering collegiality through peer teaching” (Franklin, 1993, p.2). Additionally, the project was designed to be long term, include follow-up activities, provide support to lead teachers and schools, and to encourage the development of groups of teachers who could help each other in the change process, and be responsive to the instructional level of the participating teachers.

Each participating school was represented by a team comprised of two teachers and their building principal. The lead teachers from each participating school conducted a Needs Assessment in science or mathematics or both with the teaching staff and the principal of that school. This Needs Assessment (Franklin, 1990) was based on the National Science Teachers Association Self Assessment (Voss, 1987) and rated items on importance and achievement. The Needs Assessment data for each participating school was used by that school to identify perceived strengths and weaknesses in order to develop a School Improvement Plan (SIP). The SIPs were used by each program coordinator to plan a unique professional development program that was responsive to the needs of the 12 schools in that program.

The professional development programs varied from 110 to 141 contact hours, with incomplete data on one program. Project guidelines suggested that a leadership component be included in the professional development program, that principals be involved in the development and implementation of school improvement plans, and that lead teachers would work with other teachers at their school to share activities, strategies, and equipment. Participating teachers attended three academic year sessions (about 10 contact hours), an intensive (approximately 75 contact hour) Summer Institute, about six follow-up sessions during the second academic year (10 contact hours), and a 25 contact hour Summer Workshop the final summer. While principal support and participation was a project requirement, actual support and participation varied. Lead teachers developed a variety of ways in which to share with their peer teachers; sharing strategies ranged from one-on-one contact to formal workshop presentation to the entire school faculty.

Excerpted from Russell, A.A. (1990). *The dissemination of doing chemistry. Final evaluation*. Washington, D.C.: American Chemical Society. (ERIC Document Reproduction Service No. ED 359 039).

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.

Excerpted from Slater, T.F., Coltharp, H., & Scott, S.A. (1998). A telecommunications project to empower Kansas elementary/middle level teachers as change agents for integrated science and mathematics education. *School Science & Mathematics*, 98(2), 61-66. 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 extra project 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 in service 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 in service 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.

Excerpted from Smith, P. S. & Wickwire, M. (2009). Virginia's Mathematics Specialist Institute Project: A summary of evaluation findings. *The Journal of Mathematics and Science: Collaborative Explorations*, 11, 127-139.

Horizon Research, Inc. (HRI) serves as the external evaluator for the NSF Institute's "Preparing Virginia's Mathematics Specialists" project, described in a previous article. Participants in this project do coursework at each of three Summer Institutes. These five-week residential experiences have been held on the campuses of Norfolk State, Virginia Commonwealth University, and George Mason University. During each Institute, participants complete two of the five required mathematics courses and the first half of an Educational Leadership course. Participants complete the second half of each Leadership course by February of the following year. At the third Institute, participants complete the final mathematics course, as well as a course entitled, *Mathematics for Diverse Populations*. Over three Summer Institutes, participants complete five mathematics courses. During the first Institute, participants take the *Numbers and Operations* and *Geometry and Measurement* courses. *Rational Numbers and Proportional Reasoning* and *Probability and Statistics* are offered at the second Institute, and participants complete *Algebra and Functions* at the third Institute.

These nine courses—six mathematics and three leadership courses—are the major components of the Mathematics Specialist preparation program. In our capacity as external evaluator, we have observed several days of each Summer Institute. In addition, we have surveyed Institute participants and interviewed them on several occasions. Data from these activities point to specific impacts resulting from the Institutes. In this article, we discuss three kinds of outcomes: 1) Impacts on Mathematics Content Knowledge; 2) Impacts on Participants' Perception of their Pedagogical Content Knowledge; and, 3) Impacts on Participants' Perceptions of their Leadership Skills.

Excerpted from Venville, E.M., & Jones, M.G. (1998). Gardens or graveyards: Science education reform and school culture. *Journal of Research in science Teaching*, 35(7), 757-775.

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 organized 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 A\$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 20km 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.

Excerpted from Wallace, J.D., Nesbit, C.R., & Miller, A.S. (1999). Six leadership models for professional development in science and mathematics. *Journal of Science Teacher Education*, 10(4), 247-268.

The project on which this study is based was conducted by the University of North Carolina's Mathematics and Science Education Network (MSEN) and funded by a three year-grant from the U.S. Department of Education's Fund for the Improvement and Reform of Schools and Teaching (FIRST). The FIRST project was developed to improve elementary school science and mathematics in North Carolina by supporting teams of two lead teachers and their principals from 180 schools across the state. To bring about this improvement, the teams of lead teachers made an assessment (Franklin, 1990) of the strengths and weaknesses of their schools' science or mathematics programs. Each team then developed a School Improvement Plan (SIP) designed specifically to meet their school's needs. Based on these School Improvement Plans, Program Coordinators at each university site planned a unique two-year professional development program for lead teachers that was designed to help each school carry out its plan. The project was conducted at seven sites during years one and two and eight sites during years two and three—thus a total of 15 separate programs were provided. Seven programs focused on science, six on mathematics, and two on both subjects. The professional development programs included:

1. Orientation and Planning Pre-sessions—Lead teachers and their principals learned about the project, completed a science and/or mathematics needs assessment, and each team analyzed their school's results. At most sites, these preliminary sessions also included some "visioning" activities; that is, teachers and principals were shown what an ideal elementary mathematics or science program might look like according to current national standards. Finally, lead teachers used needs assessment data and input from their faculty to develop a School Improvement Plan.

2. Summer Institute—Lead teachers at each site attended a three-week Summer Institute (approximately 75 hours) designed to help them implement their School Improvement Plans.

3. Academic Year Follow-up Sessions—During the year, teams at each site met approximately six times to receive additional training and to discuss successes, problems, and strategies.

4. Summer Workshop—A final one-week workshop (approximately 25 hours) provided additional professional development activities and future planning for the project's lead teachers.

Excerpted from Weaver, D. & Dick, T. (2009). Oregon mathematics leadership institute project: Evaluation results on teacher content knowledge, implementation fidelity, and student achievement. *The Journal of Mathematics and Science: Collaborative Explorations*, 11, 57-84.

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

Excerpted from Whitenack, J., Cavey, L., & Ellington, A. (2008) *Argumentation and the role of proof making in the preparation of K-5 mathematics specialists*. Paper presented at the Joint Meeting of the AMS-MAA, San Diego, CA, January 5-8, 2008.

In this paper, we provide a microanalysis of a lesson in a proportional reasoning course in a K-5 mathematics specialists program. We frame our analysis by employing a hypothetical account of how the course instructor might address one of the participants' claim for a case of the density property of the Real numbers. We then use Krummheuer's (1995) theory of argumentation to analyze the argument that actually unfolded during the whole class discussion. As we do so, we revisit the hypothetical framework to examine the emergence of proof making during this whole class discussion. We conclude with a discussion about the role of proof making in teacher professional development program

Our discussion is a preliminary report that grows out of our need to understand the role of argumentation in this and possibly other lessons that span several courses in our mathematics specialist degree program. We use our discussion to begin to make sense of the role that mathematical arguments might play in supporting participants' mathematical learning, and to inform our instructional goals of planning for and orchestrating informal and formal arguments around important mathematical ideas that underpin the K-5 curriculum.

At the time of this lesson, participants were completing the second year of a 3-year graduate degree program designed to support the development of K-5 Mathematics Specialists. This lesson is taken from the third of five mathematics courses in the program. Participants were also enrolled in the second of three Education/Leadership courses as part of their degree program. Participants entered the program with a range of experiences. Some had several years of teaching experience whereas other had taught fifteen or more years. About one-third of the participants were already serving in some type of leadership role in their school buildings. All participants had been selected by their school districts to participate in this program; school districts were viewed as partners in this enterprise. In fact, participating districts were asked to commit to placing the participants in some type of leadership role once the participants had successfully completed the degree program. Additionally, because this program was a statewide effort to provide a program that was endorsed by the State Department of Education, it was viewed not only as a local or district, but also as a statewide initiative that would support effective mathematics instruction and ultimately, support student learning. University faculty (both mathematics and mathematics educators) along with school district personnel (e.g., master teachers, mathematics specialists and district coordinators) collaboratively developed and co-taught mathematics and mathematics education courses. This collaboration is quite unique and has contributed in part to the relative success of developing a mathematics specialist program that trains teacher leaders to support elementary teachers and their students across the state.

The data is taken from classroom data corpus that includes observation notes of the lessons,

videotape recordings of small group and whole class discussions, digital recordings of participant interviews and small group discussions, digital photos of participants' work during whole class discussions and participants' individual work. As we observed this lesson, we noted in our observation notes if we needed to revisit particular lessons during our analysis process. Because we had marked this lesson as a potentially important lesson to analyze carefully, we decided to begin our analysis by conducting a preliminary analysis of this lesson. As we did so we realized that we needed to transcribe this lesson to conduct a more thorough microanalysis of the entire lesson.

To conduct this microanalysis, we first viewed the videotape and the transcription of the entire 54-minute small group and whole class discussion around finding a rational number between $1/11$ and $1/10$. As we watched the videotaped lesson, we identified the mathematical strategies that surfaced and clarified each of the participant's contributions as well as how the Instructor facilitated the discussion. We then developed three different mathematical trajectories that underpinned the mathematical ideas that the Instructor and the participants considered. As part of this process, we adapted an analytic method that we had used to analyze a 7th grade algebra lesson (Cavey, Whitenack, & Lovin, 2007).

Excerpted from Whitsett, G., & Riley, J. (2003). *Defining and applying leadership: Perceptions of teacher leader candidates*. Paper presented at the annual meeting of the Mid-South Educational Research Association, Biloxi, MI.

This study examined shifts in perceptions of the meaning of leadership and necessary leadership skills held by 18 teachers in a graduate program on teacher leadership. Participants were queried twice regarding their definitions of leadership; once at the outset of their degree program and again 1 year later. In between, they took classes in leadership and mentor training, professional standards, school climate, legal and fiscal involvement. Two Likert-scale surveys examined their perceptions of the importance of 11 leadership skills and of the extent to which they attained growth in each skills [sic]. Results found little variation in the relative importance participants assigned to the skills. Confidence emerged as the most important skill, followed by two skills that involved the participation widely in their assessment of personal growth in leadership skills. They perceived the greatest growth in knowledge of educational issues and understanding leadership styles. Initially, most participants defined leadership under the figurehead category. Midway through the program, half of them changed to define leadership in terms of the cheerleader/team player category.