National Science Foundation

New Jersey
Math Science Partnership

Early Childhood Education
Professional Development Component Study

July 2006

Metis Associates
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Executive Summary

Begun in October 2002, the New Jersey Math Science Partnership (NJ MSP) was a five-year, $12.3 million mathematics and science education reform initiative federally funded by the National Science Foundation (NSF). The NJ MSP involved a multifaceted collaboration of two university partners (Rutgers University and Rowan University) and 11 partner districts that span several northern, central, and southern geographic counties in New Jersey. The partner districts collectively serve over 75,000 students and, in their combined 109 schools, employ approximately 4,000 teachers of math and science. The NJ MSP was one of only two MSP projects nationally that incorporated a special focus on math and science learning in early childhood education (ECE). A full-time Early Childhood (EC) Specialist was hired by Rutgers to oversee the ECE professional development component. In September 2005, the National Science Foundation (the funding source for the NJ MSP) determined that the NJ MSP would phase out during its fourth year of implementation (by May 30, 2006) and requested that a study be conducted on the ECE component.

Study Design. The study focused specifically on the "learning communities" professional development series that was implemented in the final year of the NJ MSP initiative, from July 2005 to May 2006. Purposes of the study were to (1) describe the design rationale, goals, and objectives of the ECE component; (2) describe the level of district participation in the ECE professional development series and the characteristics of participating districts; (3) describe the implementation structure of the professional development series; (4) provide evidence on the ways in which NJ MSP met its ECE professional development objectives for improving teachers' knowledge of the exploration of math and science content, improving teachers' dispositions towards math and science, and equipping teachers with strategies to assess and support the translation of science content into the learning environment; and (5) offer lessons learned from the NJ MSP ECE component that may serve to inform other initiatives that seek to build teachers' capacity to translate math and science concepts into preK learning environments.

To conduct the study, data were obtained using multiple qualitative and quantitative sources including pre/post questionnaires administered to professional development participants, observations of professional development events, phone interviews with NJ MSP project staff and professional development participants, professional development feedback forms completed by participants, preK master teacher logs that documented coaching activities conducted with teachers, pre/post observations of preK classrooms conducted by preK master teachers to assess the quality of science teaching, and various forms of program documentation (attendance sheets, training agendas and materials, etc.).

Findings in Brief

- **The design of the NJ MSP ECE professional development component incorporated the early learning knowledge base, standards-driven focus, and capacity-building infrastructure of the New Jersey Department of Education's preK program, in addition to other well-established research- and evidence-based approaches to math and science teaching and learning.**

The New Jersey Department of Education (NJDOE) is recognized nationally as a leader in high-quality preK programming due to its establishment of *Preschool Teaching and Learning Expectations* (which identifies early learning standards in all content areas); preK teacher certification and salary requirements; adoption of evidence-based curriculum models; a 15-student preK class size limit; and assignment of a full-time "master teacher" to provide ongoing, onsite coaching for every 20 preK classrooms. The NJ MSP effectively leveraged these local strengths by including the collaboration of NJDOE officials responsible for early childhood education in its professional development design process so that it aligned with the state's early learning expectations, exposed preK educators from its partnering districts to resources and learning techniques that supported implementation of the state's recommended preK curriculum models, and tapped into the capacity building infrastructure of the state's preK program by focusing training on teams of preK master teachers and the classroom teachers that they coached. The NJ MSP ECE component was equally influenced by well-documented national and international research efforts on teaching and learning approaches in math and science at the ECE level and beyond, including professional development standards for early childhood teachers, the Reggio Emilia approach, Japanese lesson study, the *Young Scientist Series* developed by the Educational Development Center (EDC), and the University of California Irvine MSP initiative.

Using this collective knowledge base, NJ MSP refined its focus and professional development delivery approach. In the initial plan for the ECE component, the NJ MSP targeted teachers from preK to grade 1; however, the NJ MSP staff discovered that the learning environment in preK was typically not well connected to the K-1 primary grades within partner districts and that it had a unique and high degree of need with regard to increasing teachers' understanding of how to incorporate more science concepts into daily learning opportunities. The EDC's *Young Scientist Series* as an integrated curriculum resource that focused on block building was selected framework for training preK teachers and the "learning communities" approach was selected as the professional development delivery model.

- **The NJ MSP's implementation of the "learning communities" professional development series intensified the ECE component on a number of levels, including the frequency of training sessions, the number of professional development hours offered, the linkages made between sessions and classroom learning, and the documentation and examination of classroom practice.**

Over the first three years of the NJ MSP initiative, the ECE professional development events offered included a full-day curriculum showcase in spring 2003, a three-day ECE institute conducted over the spring and summer of 2004, and a full-day math workshop and a full-day, statewide ECE conference in spring 2005. In summer 2005, the "learning communities" professional development series was launched, beginning with a week-long summer 2005 Early Childhood Science Institute followed by five full-day sessions scheduled over the course of the 2005-2006 school year (from October to March). The series culminated with the second annual NJ MSP ECE Conference in May 2006. Altogether, the ECE professional development series offered 77 hours of professional development over an eight-month period. The professional development sessions were facilitated by two NJ MSP staff members, the EC Specialist and the Senior Science Specialist.

Strong linkages were made between preK classroom practices and professional development activities conducted through the ECE component. During each session of the professional development series, participants would "share stories from the classroom" regarding their application of training topics and techniques and students' responses to these approaches. Several of the follow-up sessions also included classroom visitations to observe how block building was used to promote science concepts within different preK curriculum programs. Between sessions, "learning community" participants implemented homework assignments related to professional development topics in their district or classroom settings and received ongoing implementation support through visitations and e-mails from the EC specialist and the NJ MSP Senior Science Specialist.

The professional development series embedded ongoing opportunities for participants to collect and examine documentation on the quality of science learning in preK classrooms. Each session included discussion on documentation panels of students' work, master teachers' logs of their coaching activities with classroom teachers, and/or observations of preK classrooms as carried out by master teachers using the Science Teaching and Environmental Rating Scale (STERS) developed by EDC.

- **NJ MSP partner districts demonstrated a high level of interest and engagement from the onset of the ECE professional development component; however, factors such as lack of funding and competing professional development priorities resulted in a limited number of preK educators who had direct involvement with the "learning communities" professional development series.**

Of the 11 districts that participated in the NJ MSP, 10 have preK programs. All of these districts sent staff to the four NJ MSP ECE professional development events leading up to the professional development series. Given the more intense time commitment of the "learning communities" professional development series, the NJ MSP partner districts cited barriers to participation such as a lack of funds for substitutes needed to cover teachers' classes and competing professional development priorities within the district. As such, only four districts fully participated in the professional development series.

- **Participating preK classroom teachers' and master teachers' understanding of science learning improved with regard to identifying the important elements of science, factors to consider in determining science content to address with young children, and utilizing block building as a vehicle for science exploration.**

Pre- and post-questionnaire findings indicated that participants reported an increased emphasis on the use of inquiry as the most important element in teaching science to young children. Inquiry skills engage students in learning processes through questioning, discovery, curiosity, exploring and reflecting. About a third of the responses (31%) provided by participants on the pre-questionnaire regarding what constituted their science program for young learners, identified inquiry as an important element; this increased to 76% of the responses on the post-questionnaire. In addition, participants were more likely to cite in their post-questionnaire responses (compared to their pre-questionnaire responses) that students' natural interests were a

primary factor in driving what science content teachers included in their preK programs. Professional development participants also reported that the ECE component helped them to use building blocks playtime as science learning opportunities through such techniques as familiarizing students with the different types of building blocks, focusing building activities on specific types of structures such as towers and enclosed spaces, and talking with students about the structures they built using terminology associated with science concepts.

- **Participating preK classroom teachers and master teachers reported that their dispositions toward teaching science and understanding of students' science learning was greatly enhanced by their experience in the "learning communities" professional development series.**

Feedback from interviews conducted with EC supervisors and teacher leaders indicates that information sharing and exchanges that took place within the learning community were perhaps the most enjoyable and informative aspects of the professional development sessions. Participants reported that their comfort level with trying out new techniques improved as they documented the work that students were doing with block play and had the opportunity to share and problem solve with others at the training sessions. The EC Specialist viewed the documentation panel homework assignments as a key strategy in promoting teachers' confidence in translating science concepts to children. In particular, preK teachers reported that they had become more adept at posing questions during block play that moved children's conversations to a deeper level of science inquiry.

- **The environment for science learning in preK classrooms improved among participating teachers especially in the areas of physical environment of the classroom and teachers' ability to facilitate conversations about science concepts.**

Feedback from interviews conducted with EC supervisors and teacher leaders indicate that they liked that the STERS provided an objective process for looking at indicators of science learning in the classroom. Master teachers received a full day of STERS training conducted by EDC staff and then administered the instrument in fall 2005 and again in spring 2006 in the classrooms of participating preK classroom teachers. Results from the initiate STERS administration were used to inform the focus of coaching activities conducted by the preK master teachers and led to greater emphasis on making classrooms more "science rich" by expanding the size of the block area, increasing the variety of different types of blocks, and displaying block materials, related books, and students' work in ways that were more accessible to students. Master teachers also spent time coaching teachers on how to enhance students' verbal expression of science concepts through small and large group talks.

Lessons Learned

The following lessons yielded from the NJ MSP ECE professional development component underscore the importance of an essential set of resources and design strategies that are needed in order to effect sustainable change in teaching and learning environments.

- "Time" is the critical resource that is needed in order for teachers to acquire new content and translate it into instructional strategies.
- Desired change in instructional practice is most effectively realized when it flows from "very focused" professional development.
- Teachers' acquisition and dissemination of new content requires access to experts with the necessary knowledge along with opportunities to observe, try out, and reflect upon the use of quality materials and instructional strategies.
- The linkage between the curriculum content addressed in off-site professional development session and the everyday work of curriculum development leaders fosters the translation of new concepts and techniques into classroom practice through regularly scheduled classroom visits and on-site conferences.
- Getting "all of the players on the same playing field" was critical to building the momentum of partnership support for the ECE professional development effort.
- Leadership for professional development efforts needs to be credible, informed, and able to establish collaborations between and among all of the "players" in order to navigate through the myriad of challenges that often occur over the course of a sustained professional development model.

NJ MSP Early Childhood Education Professional Development Component

I. Introduction

Begun in October 2002, the New Jersey Math Science Partnership (NJ MSP) was a five-year, $12.3 million mathematics and science education reform initiative federally funded by the National Science Foundation (NSF). Goals of the NJ MSP were to:

1) Increase achievement and reduce achievement gaps in mathematics and science between children from families that differ in wealth and ethnicity; and
2) Document and evaluate NJ MSP implementation and outcomes in order to support the partnership in a formative manner and to inform the broader P-16 learning community.

The NJ MSP involved a multifaceted collaboration of two university partners (Rutgers University and Rowan University) and 11 partner districts that span several northern, central, and southern geographic counties in New Jersey. The partner districts collectively serve over 75,000 students and, in their combined 109 schools, employ approximately 4,000 teachers of math and science. The NJ MSP was one of only two MSP projects nationally that incorporated a special focus on math and science learning in early childhood education (ECE). The interest in developing an ECE component emerged from an identified need within the context of public education in New Jersey where Abbott districts are required to provide early childhood education for all pre-school aged children.[1] Of the 11 NJ MSP districts, 10 provide ECE programs, and seven of these districts have the Abbott designation. As stated in the NJ MSP funding proposal:

> *Providing assistance for pre-kindergarten is especially pressing in New Jersey where the Supreme Court has mandated that the [state's] 30 Abbott districts provide high quality early childhood education for every child. Yet, strategies for preK reform are not as well developed as in higher grades…However, guidelines for [preK] curriculum and appropriate instruction are still being formulated (and science is not as well developed as mathematics).*

This report focuses on the NJ MSP ECE component, specifically, the "learning communities" professional development series that was implemented in the final year of the initiative, from July 2005 to May 2006. The remainder of the report is structured as follows:

- Section II presents the NJ MSP theory of action and the specific research questions and methodology that were used to conduct the study of the NJ MSP ECE component;
- Section III provides background information on the design rationale, goals, and objectives of the ECE component;

[1] New Jersey has 30 "Abbott" districts, a designation brought on by a lawsuit (Abbott vs. Burke) that resulted in a 1981 State Supreme Court ruling to provide adequate funding for the state's poorest districts to ensure every student is provided with a thorough and efficient education. In May 1998, Abbott districts were mandated to provide a full-day, full-year, high-quality preschool education to three- and four-year old children.

- Section IV presents information on the level of district participation in the ECE professional development series, barriers to participation that were encountered, and the characteristics of participating districts;
- Section V describes the implementation structure of the professional development series and participant feedback on the quality, usefulness, and limitations of information discussed at the various sessions;
- Section VI presents evidence on the ways in which NJ MSP met its ECE professional development objectives for (1) improving teachers' knowledge of the exploration of math and science content, (2) improving teachers' dispositions towards math and science, and (3) equipping teachers with strategies to assess and support the translation of science content into the learning environment, as well as challenges encountered during the implementation process; and
- Section VII offers lessons learned from the NJ MSP ECE component that may serve to inform other initiatives that seek to build teachers' capacity to translate math and science concepts into preK learning environments.

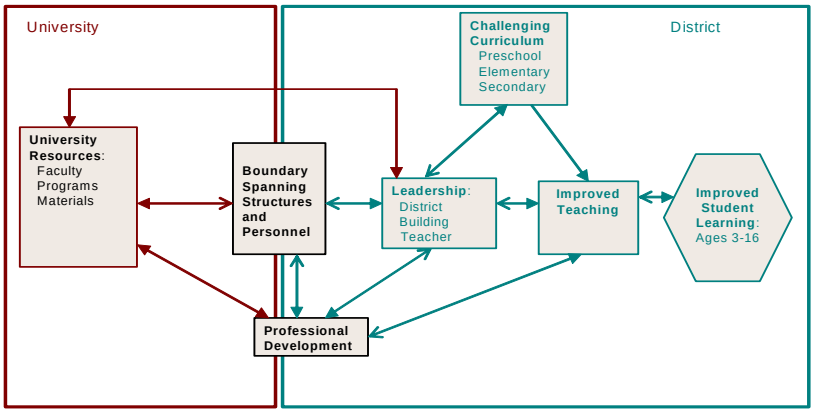
II. Research Questions and Methodology for the NJ MSP ECE Professional Development Study

The NJ MSP was funded as a comprehensive MSP, meaning that its goals were to impact teaching and learning in both mathematics and science and throughout the preK-to-16 span. The operational framework for impacting teaching and learning on such a broad scale is reflected in the NJ MSP theory of action (see Figure 1). This theory of action conceptualizes the process of change that was expected to occur through the implementation of the initiative. The theory is grounded in research on the phenomenon of "boundary spanning" roles within partnerships, wherein people and structures serve to bridge cultures, resources, and ideas between separate but similarly oriented operating systems (Fleming and Waguespack, 2005; Louis and Sieber, 1979). Boundary spanning theories are considered effective in facilitating the partnership process between K-12 and university learning environments (Firestone and Pennell, 1997; Hall and Hord, 2001).

Key conduits for boundary spanning were the NJ MSP linking agents[2] and various committees, task force groups, and other planning structures that were developed through the initiative to foster interactions between university faculty and district staff. It was anticipated that these interactions would result in short-term outcomes in areas of district planning and provision of content- and standards-based professional development; intermediate outcomes in the areas of leadership (across the P-16 span), teaching force retention, and challenging curriculum; and long-term outcomes for student achievement.

[2] Linking agents represented university-based staff with content expertise in math or science who were assigned to interact regularly with one to two partner districts in developing and implementing MSP strategic plans; brokering or providing professional development; examining, selecting, and/or implementing standards-based math and science curricula; and providing a host of other forms of technical assistance.

Figure 1: NJ MSP THEORY OF ACTION



In September 2005, the National Science Foundation (the funding source for the NJ MSP) determined that the NJ MSP would phase out during its fourth year of implementation (by May 30, 2006) and requested that a study be conducted on the ECE component.[3] The study focused on the ECE professional development series and was designed to address the following research questions:

- What were the design rationale, goals and objectives of the ECE professional development series?

- How was the ECE professional development series implemented? Which districts and staff members comprised the learning community that was fostered through the ECE professional development series and to what extent did they participate? How did participants rate the quality of the sessions provided and their level of interest in topics discussed?

- In what ways did the NJ MSP ECE professional development series meet its objectives for (1) improving teachers' knowledge of the exploration of math and science content; (2) improving teachers' dispositions toward math and science, and helping them to translate content knowledge to the targeted age group; and (3) equipping teachers with strategies to assess and support the translation of science content into the learning environment? What challenges to implementation were encountered?

- What lessons emerged from the pilot implementation of the NJ MSP ECE professional development series?

[3] The NJ MSP contracted Metis Associates to conduct the study. Founded in 1977, Metis Associates is an independent educational research and evaluation firm that provides technical assistance and professional support for a wide range of human services initiatives that involve program evaluation, policy analysis, program development, and computer system design activities.

Data were obtained through multiple qualitative and quantitative sources to address these questions. Below is a description of the data collection methods that were used to conduct the study.

Observations of NJ MSP ECE Professional Development. Metis researchers were present at each professional development event held during the project pilot. A semi-structured observation form was used and customized for each event to document participation levels, session structure and content, key discussion and decision points, and materials distributed. An example of a customized observation protocol is presented in Appendix A.

Pre/Post Questionnaires and Learning Goals Feedback Protocols were administered during the kick-off ECE professional development event (the July 2005 week-long science institute) to participating preK master teacher and classroom teachers. These protocols solicited participants' perceptions about the importance of science in their education program, the science elements that were included in their program, learning activities used to incorporate science, strategies used to assess science learning, and goals for improving science learning in their preK programs. SPSS text analysis software was used for data reduction of the qualitative data into categories. The questionnaire and the detailed content analysis results are presented in Appendix B.

Professional Development Participant Background and Attendance Records. ECE professional development participants completed a form that collected information about their professional backgrounds and current job assignments. Information from this form (along with hard copy attendance records) was entered into an Access database. These professional development data were analyzed using descriptive statistics to extract unduplicated counts on the types, number, and hours of NJ MSP ECE professional development in which master teachers and classroom teachers participated during the initiative. See Appendix C for copies of the professional development participant form.

Professional Development Participant Feedback and Reflection Forms. Customized feedback forms were distributed at the conclusion of each institute, follow-up session, and conference event that was conducted as part of the NJ MSP ECE professional development component. Participants were asked to rate the quality of each session they attended and their level of interest in learning more about each session topic (on a scale of 1-to-5, with 1 being "low" and 5 being "high"). In addition, participating master teachers and classroom teachers were asked to complete a "reflection form" at the last follow-up session, which was conducted in May 2006. The reflection form solicited feedback on whether and in what ways the ECE professional development component had influenced their mentoring and/or teaching approaches in science and in other areas of their education program, as well as challenges encountered and accomplishment made in achieving the goals that were set at the beginning of the project. An example of a customized feedback form and the reflection forms are presented in Appendix D.

NJ MSP EC Specialist Phone Interviews were conducted in October 2005 (informal interview) and May 2006 (structured interview) to gather information about the process of project planning and the nature of linking agent contacts made with individuals at the district, school, university, and New Jersey Department of Education levels. The interview also explored this linking agent's perceptions about key accomplishments, challenges encountered and resolved, and

persisting barriers with regard to attaining project objectives. The May interview protocol is presented in Appendix E.

Early Childhood Education District Team Phone Interviews were conducted in May 2006 in the four districts that participated in the pilot ECE professional development effort. The interview included EC supervisors and master teachers (where applicable) and explored the extent to which information, resources, and documentation tools and strategies obtained by professional development participants (master teachers and classroom teachers) were being shared and/or utilized more broadly within the district's preK program. Feedback was also obtained regarding the extent and nature of local planning for ongoing use of strategies and tools that were introduced through the NJ MSP. The interview protocol is presented in Appendix F.

The ***Science Teaching and Environmental Rating Scale*** (STERS), an instrument developed by the Education Development Center (EDC),[4] is designed to measure the quality of science teaching as documented through classroom observation and pre/post observation teacher interviews.[5] It organizes science teaching into seven components; five of these components are documented through the classroom observation (the physical environment for science learning, science-related hands-on exploration, representation of science experiences and ideas, use of oral and written language in science inquiry, and small and large group science talks) and two components through teacher interviews (planning for in-depth science investigations and assessing children's science learning). PreK master teachers[6] from the NJ MSP districts that participated in the ECE professional development component attended training sessions (conducted by EDC and the NJ MSP EC Specialist) on how to collect and score STERS data. The STERS was administered by master teachers in fall 2005 and spring 2006 in the classrooms of their collaborating teachers who participated in ECE professional development.[7] Copies of the STERS instrument and scoring rubric are presented in Appendix G.

Master Teacher Logs, completed by master teachers who participated in the ECE professional development series, served as a tool to document the frequency, focal areas, and methods used to provide coaching to preK classroom teachers on strategies for making the classroom environment more conducive to science learning. Information from the logs was tallied and summarized. The master teacher log template is presented in Appendix H.

III. Design Rationale, Goals and Objectives of the NJ MSP Early Childhood Education Professional Development Component

Congruent with the implementation approach depicted in the NJ MSP theory of action, a unique "linking agent" given the title of Early Childhood (EC) Specialist was hired at Rutgers

[4] EDC is an international, nonprofit organization headquarted in Newton, MA, with more than 325 projects dedicated to enhancing learning, promoting health, and fostering a deeper understanding of the world. For over 40 years, its award-winning programs and products, developed in collaboration with partners around the globe, consistently advance learning and healthy development for individuals of all ages.

[5] The classroom observation typically lasts between 45 minutes to 1.5 hours and the pre/post interviews are 15 to 20 minutes each.

[6] Detailed information on the role of preK master teachers is provided in Section III of the report.

[7] More information on the STERS administration process is presented in Section VI of the report.

University in January 2004 specifically to design and oversee implementation of the NJ MSP ECE professional development component. In this linking agent capacity, the EC Specialist worked across partner districts and in collaboration with the other NJ MSP university-based linking agents who were assigned to provide training and technical assistance to specific partner districts. With 15 years of experience in various early childhood settings, the EC Specialist set out as her first priority to engage in a series of meetings and discussions with ECE educators at the district and state levels, and with other NJ MSP linking agents to gain perspective and understanding about the landscape of ECE programming, in particular strategies and resources used to promote math and science learning. Much of the EC Specialist's first year was devoted to this engagement process, the results of which led her to determine that operating an effective professional development program (with a high probability of being sustained beyond the MSP grant period) hinged upon several actions:

(1) Refining and intensifying the focus of the NJ MSP ECE professional development effort, which, in the initial ECE activities that were conducted by NJ MSP, targeted teachers preK-to-Grade 1 and were scheduled several months apart;

(2) Leveraging the knowledge base and infrastructure of staff development that was being utilized by the New Jersey Department of Education (NJDOE) Office of Early Childhood Education (OECE); and

(3) Augmenting the existing preK infrastructure by bringing to the table research-based, integrated learning approaches and program assessment tools that enhanced collegial discussion and classroom practices, primarily focused on science.

Refining and Intensifying the NJ MSP ECE Professional Development Effort

During the early implementation phase of the ECE professional development component, all of the partner districts had some level of participation because the effort initially targeted teachers working with students from preK to Grade 3. Over the first three years of the initiative, a variety of ECE professional development events were held that included a curriculum showcase in spring 2003, an ECE institute conducted over the spring and summer of 2004, and a math workshop and a statewide ECE conference in spring 2005. An overview of each of these events is provided below.

Early Childhood Showcase (Spring 2003). The showcase was a one-day event held in May 2003 and attended by over 70 early childhood educators from the 11 NJ MSP participating districts along with Dr. Ellen Frede, the Assistant to the Commissioner for Early Childhood Education, NJDOE and two plenary session presenters: Dr. Catherine Twomey Fosnot from City College of New York who addressed the audience on the topic of "Mathematizing a Child's World" and Ms. Karen Worth from the Education Development Center, who presented the topic of "Young Children and Science." In addition, the showcase highlighted several standards-based curriculum programs that promoted math and science learning in classrooms ranging from preK through Grade 3. Participants engaged in small, hands-on breakout sessions focused on the following curriculum programs and materials:

- *Young Mathematicians at Work*

- Tool-Kit for Early Childhood Science
- *Big Math for Little Kids*
- Vermont Center for the Book
- *Investigations in Number Data and Space*
- *FOSS* – Kindergarten Activities
- *GEMS* – Peaches
- *The Young Scientist Series*

Early Childhood Institute (Spring and Summer 2004). As a follow up to the showcase, the NJ MSP initiative conducted a more in-depth, three-day professional development institute. The first day of the institute, conducted in May 2004, was attended by 66 early childhood educators (primarily working with grades preK-to-Grade 1) from the 11 NJ MSP partner districts. Day one presenters included Dr. Fosnot and Ms. Worth who each provided a morning and afternoon 1.5-hour "mini-course" in their respective content area specialty. The second two days of the institute were conducted in July 2004 and attended by 45 educators from the partner districts. Sessions presented during the institute engaged participants in discussions of the "big ideas" in science and math concepts, utilizing particular strategies and materials within the context of everyday learning activities to reinforce these concepts with children. Karen Worth was brought back a third time to serve as the science facilitator and Angela Andrews served as the math facilitator during the institute.

First Annual NJ MSP ECE Conference (Spring 2005). In March 2005, the NJ MSP conducted its first ECE conference, which was entitled, "Beyond Expectation: Implementing the NJ Preschool Expectations in Mathematics and Science." Ten of the NJ MSP partner districts participated, registering over 100 early childhood educators to participate in this event. The full-day conference was jointly planned with the NJDOE OECE and consisted of a keynote address and five workshops. The keynote address was on developmental cognitive science and presented by Dr. Rochel Gelman from Rutgers University Department of Psychology. Workshop topics addressed math and science for early learners, as well as techniques for using inquiry and technology to support math and science exploration. Workshop presenters included two NJ MSP linking agents, two OECE staff members, and a Rutgers faculty member. Conference participants had the option of choosing two of the five workshops to attend (one in the morning and one in the afternoon); each workshop lasted 1.5 hours.

May Workshop on Math Learning (Spring 2005). In May 2005, the NJ MSP co-sponsored a one-day workshop with the NJ Statewide Systemic Initiative (NJ SSI). The event attracted 35 participants from the partner districts. The featured presenter, Dr. Cathy Topal from Smith College, engaged participants in a series of techniques that used art materials to explore mathematical concepts with early learners.

Over the course of implementing these early stages of ECE professional development component, the NJ MSP staff discovered that the learning environment in preK was typically not well connected to the K-1 primary grades within partner districts and that it had a unique and high degree of need with regard to helping districts improve the quality of math and science teaching and learning. Thus, it was decided that this component would focus exclusively on preK and increase the frequency of professional development sessions in order to provide a more

feasible plan for strengthening its implementation and impact, with the long-term goal of moving towards stronger articulation with the primary grades.

Leveraging the Knowledge Base and Infrastructure of PreK Programming in New Jersey

The NJDOE OECE has distinguished itself and the state by operating one of the top early childhood programs in the nation. New Jersey is one of four states recognized as a leader in its efforts to provide a universal high-quality preschool program, meeting nine of 10 quality benchmarks of ECE programming established by the National Institute for Early Education Research (Barnett, Hustedt, Robin and Schulman, 2004). Abbott preschool programs are housed in a locally determined mix of childcare center and school-based classrooms with a maximum size of 15 students and are taught by certified teachers who are paid salaries equivalent to other public school teachers. The state mandates that Abbott districts have one or more district-level ECE supervisors (depending on preK enrollment size) and, at the school level, at least one full-time master teacher for every 20 EC classrooms. Per pupil expenditures at the preK level total more than $8,700, higher than the amount provided by any other state. Children enrolled in Abbott preschools receive a full-day education program, with before- and after-school and summer wrap-around services provided by the state's Department of Human Services for 245 days per year. As of May 2005, over 43,000 preschoolers were enrolled in an ECE program statewide, representing more than 80% of three- and four-year olds in the Abbott districts. New Jersey also provides funding for preschool programs in its 102 non-Abbott districts, but only one-fifth as many students in those districts participate in preschool programs.

The OECE developed the *Preschool Teaching and Learning Expectations: Standards of Quality* to provide a framework for obtaining developmentally appropriate learning outcomes with preschool students (the complete *Learning Expectations* document is presented in Appendix I). The state identified five evidence-based curriculum models that align with these standards from which Abbott districts must select in implementing their preschool programs: Bank Street Developmental Interaction Approach, *The Creative Curriculum*, *Curiosity Corner*, *High/Scope*, and *Tools of the Mind* (New Jersey Department of Education, 2005). To assess students' development in meeting the standards, the OECE trains teachers to implement a performance-based assessment process called the *Early Learning Assessment System* (ELAS) that involves ongoing observations of students' use of language in their natural learning environment and examinations of students' work samples. To assess the quality of preschool programs, the state instituted the *Self-Assessment Validation System*

NJDOE *Learning Expectations* for Science:

1. Children develop inquiry skills, including problem-solving and decision-making.
2. Children observe and investigate the properties of objectives, both living and nonliving.
3. Children explore the concept of change in both living and nonliving entities and in the environment.
4. Children develop an awareness of the environment and human responsibility for its care.

NJDOE *Learning Expectations* for Math:

1. Children demonstrate an understanding of number and numerical operations.
2. Children develop knowledge of spatial concepts, e.g., shapes and measurement.
3. Children understand patterns, relationships, and classification.
4. Children develop knowledge of sequence and temporal awareness.
5. Children will use mathematical knowledge to represent, communicate, and solve problems in their environment.

(SAVS) that is comprised of a series of classroom observations and fiscal accountability protocols that are administered annually (Lamy, Frede, Seplocha, Strasser, Jambunathan, Juncker, and Wolock, 2005).[8] ECE supervisors and master teachers are trained to conduct annual observations of each preK classroom and data is used to inform planning for professional development. Master teachers play an integral role in planning and implementing local ECE professional development plans and are expected to spend a lot of their time observing and modeling classroom practices; and providing feedback and coaching directly to teachers. Master teachers receive ongoing professional development as well through OECE courses, monthly master teacher meetings, and other venues.

All of the initial ECE professional development events conducted by the NJ MSP were designed to address and align with the expectations and, upon joining the initiative, the NJ MSP EC specialist became steeped in the state's ECE learning expectations and the preK curriculum models as well. The EC Specialist reached out to EC supervisors in the partner districts, conducting on-site visitations in order to: (1) increase her knowledge about existing preK programs by observing classrooms and reviewing curriculum materials, (2) making EC educators more aware of the NJ MSP and sharing information and resources through a website link that was established for the ECE component on the NJ MSP website, and (3) launching the NJ MSP ECE professional development process by successfully networking at the state level with OECE officials who invited her to attend monthly master teacher professional development sessions and agreed to collaborate with the NJ MSP in conducting several professional development conferences. In March 2005, the NJ MSP conducted its first ECE professional development conference (in collaboration with OECE), which served to reinforce understanding of the EC learning expectations in Abbott districts and introduce these standards to participating non-Abbott districts. The conference offered sessions that provided strategies for incorporating the standards into everyday classroom activities.

These interactions with partner districts and the NJDOE garnered further insight for the initiative in how to leverage OECE's capacity building structure of utilizing master teachers to coach and mentor preK classroom teachers. The EC Specialist knew that NJ MSP needed to augment this model by providing professional development to both groups in a variety of commonly shared and individually customized workshop sessions. In addition, because the Abbott partner districts already had evidence-based preK curricula in place (primarily focused on literacy and math), and most of the non-Abbott partner districts had established curriculum programs as well, the EC Specialist was able to determine (based on district feedback after the first two years of the ECE component) that the professional development needs were greatest in the area of delivering an "integrated approach" that incorporated more science concepts.

To reinforce science content learning in a feasible manner that would not overwhelm preK teachers, the NJ MSP ECE professional development focused on block building. As the EC

[8] Classroom observation tools currently being used include (1) the Early Childhood Environment Rating Scale (ECERS) that provides a rating system to assess learning environment factors such as space and furnishings, personal care routines, language-reasoning, activities, interaction, program structure, and parents and staff; (2) the Support for Early Literacy Assessment (SELA) which measures the extent to which classroom materials, activities, and interactions support early literacy development; and (3) the Preschool Classroom Mathematics Inventory (PCMI), which measures the materials and methods used to support development of math skills.

Specialist stated, "I sought to increase the frequency of interactions [among] teachers and children [with] curriculum that would be considered quality science through activities that were genuinely interesting to children. Making structures, using blocks involves measurement and numbers, and can expand to other curriculum areas."

Incorporating Research-Based Approaches and Tools to Enhance Science Teaching and Learning in PreK Classrooms

In designing its ECE professional development, the NJ MSP utilized various strands of research, research-based products, and other MSP research activity on ECE learning in math and science that was being conducted by the University of California at Irvine to shape the project's thinking on how to execute an effective capacity building effort. An overview of each research strand is provided below.

Integrated Professional Development Standards for Early Childhood Mathematics and Science Teachers (Copley and Padrón, 1999). This research strand focuses on teaching standards and synthesizes the work on professional teaching standards developed by three national teaching organizations to create a list of common elements or "integrated standards" for early childhood teaching in mathematics and science. The standards emphasize:

- developing confidence and positive dispositions towards math and science among ECE teachers;
- facilitating teachers' learning and application of appropriate math and science content through observing their students' natural interests and questions that offer opportunities for learning in these areas;
- situating professional development within a "learning community" context that is conducive to gaining teachers' acceptance and willingness to try new strategies and reflect upon their experiences with peers both equally and more experienced than themselves; and
- equipping teachers with strategies to integrate math and science learning into the preK learning environment.

The Reggio Emilia Approach (Edward, Gandini, and Forman, 1998). This research strand focuses on the process of determining what is taught and how content is explored in the preK classroom. The Reggio Emilia principles incorporate the use of:

- emergent curriculum (content that evolves from the natural interests and conversations of children);
- representational development (providing students' access to learning tools and experiences that engage a diverse array of learners or multiple intelligences);
- collaborative group work (children are encouraged to voice their perspectives and work together on projects);
- documentation of children's actions, interactions and products (teachers photograph, compile, and discuss students' work with their students, with parents, and among themselves to promote a dynamic process of learning and reflection); and
- the physical environment (student work is prominently displayed, and classroom space is organized into areas for large and small group projects, and individual activities).

Japanese Lesson Study Approach (Takahashi and Yoshida, 2004). This research strand focuses on a teacher-centered professional development approach and utilizes ongoing, systematic peer-based classroom observations, critiques, and other collegial exchange activities to help teachers explore "big ideas" underlying curriculum content and to learn from each other's classroom experiences to jointly problem solve and develop strategies for engaging students in the learning process.[9]

The Educational Development Center (EDC) Research Products – The Young Scientist Series and the Science Teaching and Environmental Rating Scale (STERS) (Chalufour and Worth, 2004-2005). *The Young Scientist Series* is a research-based preK science curriculum that incorporates learning into children's play and consists of three teacher guides and professional development support materials. As mentioned previously, Karen Worth served as a featured speaker in several NJ MSP ECE professional development events; thus, preK educators from the partner districts were familiar with the series. Concepts explored through this curriculum series are presented in three parts, each focused on specific, developmentally appropriate science concepts for early learners: *Discovering Nature with Young Children* (focused on the living world), *Building Structures with Young Children* (focused on the physical elements of structures), and *Exploring Water with Young Children* (focused on properties of water). EDC developed the STERS tool to assess science teaching. The STERS organizes the observation of science teaching into seven components that are central to the *Young Scientist* learning approach: (1) creating a physical environment for inquiry and science learning, (2) facilitating science-related, hands-on exploration, (3) encouraging representation of science experiences and ideas, (4) using oral and written language in science inquiry, (5) facilitating small- and/or large-group science talks, (6) planning in-depth science investigations, and (7) assessing children's science learning.

The University of California Irvine (UCI) MSP Initiative. UCI is implementing its Faculty Outreach Collaborations Uniting Scientists, Students (FOCUS) initiative with three districts. The initiative concentrates on developing teacher leaders, linking literacy to math and science across the preK-to-12 grade span, and increasing the quality and quantity of teachers in math and science. Based on the content of conversations and observations during a fall 2005 site visit by the NJ MSP EC Specialist, two foci were strengthened in the planning of subsequent professional development sessions: (1) the linking of literacy with science in order to foster teacher-child discussions involving science content about children's experiences as they engaged in building structures, and (2) linking with teacher leaders, supporting the mentoring process, and disseminating the achievements of the initiative.

Goals and Objectives of the ECE Professional Development Component

The NJ MSP EC Specialist developed an implementation plan and participant recruitment materials that described the goals and objectives of the ECE professional development component. Below are excerpts from these documents that outline the goals and objectives for the professional development model.

[9] Two NJ MSP districts that participated in the pilot of the ECE professional development (Plainfield and New Brunswick) implemented lesson study under a separately funded grant from the U.S. Department of Education.

> "Realizing the need for professional development that strengthens science content knowledge and that supports teachers in making positive improvements in the classroom over time, the NJ Math Science Partnership designed a professional development series specifically for early childhood teachers and master teachers (or [in the case of non-Abbott districts] teacher leaders and supervisor) teams from six New Jersey public school districts.
>
> With the national spotlight on literacy and math, quality professional development in science is not usually a high priority. Early childhood educators can now take advantage of this quality, no cost professional development series that will enhance the current science program, while also weaving in literacy and math experiences for young children.
>
> The goal of the early childhood component is: *to improve the expertise of early childhood educators in math and science by providing professional development and ongoing support to improve the quantity and quality of math and science classroom learning experiences.* NJ MSP proposes to do this by providing professional development that would increase the frequency of science and math activities and alignment [of these activities] with the *NJ Preschool Teaching and Learning Expectations.* In addition, the professional development would help classroom teachers and master teachers who are mentoring them to develop the content and pedagogical content knowledge to teach math and science to young children."

The implementation plan goes on to state that:

> "Building on the Early Childhood Institute initiated in Year 3 of this [MSP] project with Karen Worth from EDC, the professional development series was designed to:
>
> 1. **Improve the knowledge base of teachers in mathematics and science.** Ingrid Chalufour and Jeffrey Winokur from EDC [will introduce] teacher and master teacher teams from six NJ MSP districts to **Building Structures with Young Children** [from the *Young Scientist* series] at the summer Early Childhood Science Institute in 2005. The focus of this [professional development] will give teachers the opportunity to learn science concepts associated with building with blocks.
>
> 2. **Improve teachers' dispositions toward math and science, and help them translate content knowledge to the targeted age group.** Two 'learning communities' will meet five times during the 2005-2006 year to build on what they have learned at the summer institute and to reflect on practice as they begin to introduce science into the classroom. The learning communities are [to be] composed of six [primarily] Abbott districts, and all serve children with special needs, children who are English language learners and children from diverse, economically disadvantaged communities.
>
> 3. **Learn instructional strategies that carry the translation of content into the classroom.** As teachers set up classroom science learning opportunities, master

> teachers will assess their progress using the new science assessment tool (STERS – Science Teaching and Environment Rating Scale) to document strategies that can improve science teaching. STERS will be used as a way of establishing common elements for discussion in the learning communities that improve the quality of teaching and learning science."

The EC specialist elected to use a "learning communities" approach to span the boundaries of activities such as collegial discourse, observing classroom practice, and accessing and examining students' work across partner districts and with university- and NJDOE-based staff. In learning communities, teachers collaborate in developing understandings of new ideas, generate common goals for work with children, and support and strengthen each other's efforts to translate new knowledge into classroom practice. This is achieved through shared professional development experiences including acquiring new content through lecture, demonstration and direct experimentation, and discussions about what is being learned during and after the direct experience. The implementation plan for carrying out this approach included 10 days of professional development that commenced with a five-day science institute and then five follow-up sessions during the course of the 2005-2006 school year (from October to March), culminating in a presentation of teachers' work with students at the second annual NJ MSP ECE Conference scheduled in May 2006.

IV. NJ MSP District Participation in the ECE Professional Development Series

Of the 11 NJ MSP partner districts, 10 implement preK programs. Of these 10, seven are Abbott districts. Prior to the July 2005 kick-off of the NJ MSP ECE "learning communities" professional development series, various efforts were conducted to make these districts aware of and secure their buy-in regarding the professional development series. The EC Specialist made announcements and shared detailed information about the series during the spring workshop and conference that were conducted through the ECE component. In March 2005, the EC Specialist mailed applications to register for the series to EC supervisors and math and science curriculum specialists in each partner district (this series announcement and application were also posted in the NJ MSP website). The application included an overview of the program's rationale, professional development goals and focus, eligibility requirements, participant expectations, and implementation timeline. The EC Specialist followed up this mailing with phone calls to all recipients. In addition, NJ MSP linking agents assigned to work with specific districts were encouraged to make additional contacts related to generating interest and facilitating the application submission process.

All NJ MSP districts were encouraged to participate. In order to participate in the professional development series, districts had to identify at least one two-person team that would commit to attending the 10 days of training and conduct the in-between session assignments, as well as a final presentation of the collected documentation of classroom activities and students' work. In the case of Abbott districts, the team would include a master teacher and preschool classroom teacher assigned to that master teacher. In non-Abbott districts, the team could include two preschool teachers or a preschool teacher and a supervisor or teacher leader. As an incentive, participation in the series would count towards completion of the state's mandate of 30 hours of

professional development annually for teachers. Background forms related to current assignment, teaching and preK teaching experience, certifications, and education were to be completed by each member of the team and submitted with the application. NJ MSP did not provide stipends to participants or funds to cover substitutes. As such, local leadership buy-in was considered important to ensuring effective implementation of this professional development effort and a letter of support from the principal or center director where participants were based had to be included as part of the application submission. It was anticipated that 20 teams would be selected to participate in the professional development series.

Five of the 10 partner districts that operated preK programs had at least one team participate in the kick-off event of the professional development series—a week-long summer science institute. Four Abbott districts and one non-Abbott district participated.[10] EC Supervisors from the participating districts shared the following comments regarding their motivation to register: It was an "opportunity to provide our teachers with in-depth science [and] math training that can be shared collaboratively to benefit our students….it was something the master teachers took upon themselves to do [because they] wanted an opportunity to improve their work….We had been a part of the NJ MSP [professional development] for [early childhood] from the onset, about three years ago. We were interested in continuing the collaboration and, quite frankly, [the professional development] kept getting better each year. It really interested us to continue to see what the next steps would be."

Participating Districts in ECE Professional Development Series by Geographic Region

Western New Jersey
Phillipsburg

Central New Jersey
New Brunswick
South Bound Brook*

Southern New Jersey
Bridgeton
Vineland**

*Denotes non-Abbott district
**Participated in the summer institute only

Nonetheless, the EC Specialist identified district participation as a continuing challenge throughout the development of the ECE component, "I was unable to reach as many districts as I wanted. I know that if we had more time to make connections, more would have joined." However, there did appear to be some miscommunication about the number of teams or participants each district could involve in the professional development series. An EC supervisor from one district recommended that the impact of NJ MSP initiatives could be strengthened by informing the supervisors of "exactly how many teachers can participate. The reason why I say that is because during the summer workshop, Vineland came with a team of almost 10. I didn't realize that we could have that many people so I only brought a team of four. I think I could have had more people attend if I had known [that I could bring more]… I had no idea that bringing more people was even permissible." The size of the participating group became viewed as an opportunity to launch the series as a "pilot effort," working with a core cadre of preK educators to develop the program and identify lessons for improving and sharing the implementation experience.

[10] A sixth partner district, Plainfield, also expressed interest in participating in the professional development series. However, the district was already involved in an extensive training effort for preK teachers and master teachers related to the ELAS instrument during the 2005-2006 school year. One of Plainfield's preK teachers attended some of the summer 2005 institute, but was not able to continue with the program for personal reasons.

Of the five districts that registered for the series, one is located in the far western region of New Jersey, three are located in the central region, and two in the southern region. Between 100 to 120 miles separates each region from the next, and due to these geographic distances, the EC Specialist initially structured the series so that the entire group could work together during the science institute and then two "learning communities" would be formed to meet monthly during the school year before the entire group would reconvene at the end of the project to share their documentation panels and lessons learned. One learning community would consist of the three districts located in the central and western regions (New Brunswick, Phillipsburg, and South Bound Brook) and the other learning community would meet in the southern region (Bridgeton and Vineland).

Initially, all five districts that had teams who completed the science institute planned to participate in the learning community follow-up sessions that occurred during the fall and spring of the 2005-2006 school year. Upon notification of the phasing out of the NJ MSP, however, one southern district elected to drop out because of the lack of funds available for substitute teacher coverage. Consequently, one learning community was formed that was made up of the remaining four districts. The schedule and locations of the five follow-up sessions and culminating statewide conference event were finalized as follows:

1. October 20 – South Bound Brook; November 2 – Bridgeton[11]
2. January 12 – Rutgers University
3. February 9 – South Bound Brook
4. March 9 – Phillipsburg
5. March 29 – Rutgers University

May 4 – 2nd Annual NJ MSP ECE Conference at Teachers' College of New Jersey

Participating Districts' Characteristics

As shown in Table 1, the 2005-2006 enrollment size of the participating districts ranged from 6,742 students in New Brunswick to 490 students in South Bound Brook. The ethnic breakdown of students also varied widely across districts. The majority of Bridgeton's students are African-American (44%) and Hispanic (42%). New Brunswick is primarily Hispanic (72%) and Phillipsburg is largely Caucasian (79%). The majority of South Bound Brook's students are Caucasian and Hispanic (41% each). Bridgeton and New Brunswick serve students populations that are predominantly poor, although Phillipsburg and South Bound Brook also serve a significant portion of economically-disadvantaged students.

[11] The Vineland district's decision to withdraw from the series occurred after the central New Jersey learning community had completed the first follow-up session, so a separate first session for the Bridgeton district was conducted.

Table 1
Participating Districts' Demographics

District	District Enrollment	Caucasian	Hispanic	African-American	Asian/ Pacific Islander	Free or Reduced Price Lunch
Bridgeton	4,536	13%	42%	44%	1%	78%
New Brunswick	6,742	2%	72%	25%	1%	65%
Phillipsburg	3,603	79%	10%	9%	2%	41%
So. Bound Brook	490	39%	44%	12%	5%	30%
Total (Mean %)	**15,371**	**33%**	**42%**	**23%**	**2%**	**54%**

Source: New Jersey Department of Education

These districts also differed in terms of their 2005-2006 preschool enrollment as shown in Table 2. Districts participating in the follow-up sessions collectively serve 2,416 three- and four-year-olds. In order to meet the needs of the eligible preschool population, Abbott districts often rely on community-based childcare providers external to the district to supplement their within-school preK programs.[12]

Table 2
Participating Districts' PreK Program Characteristics

District	Total PreK Enrollment	Enrollment by Location		Total Number of:		PreK Curriculum
		In-District	Childcare Center	Classrooms	Master Teachers	
Bridgeton	758	390 (51.5%)	368 (48.5%)	49	3	*Tools of the Mind*
New Brunswick	1,250	75 (6.0%)	1175 (94.0%)	87	6	*Creative Curriculum*
Phillipsburg	375	210 (56.0%)	165 (44.0%)	25	2	*Creative Curriculum*
So. Bound Brook[1]	33	33 (100%)	0 (0%)	3	--	*Tools of the Mind*
Total	**2,416**	**708 (29.3%)**	**1708 (70.7%)**	**164**	**11**	

Source: Documentation provided by NJ MSP project staff as obtained from participating districts' EC supervisors or lead teachers.

[1] South Bound Brook has a preK program that operates differently from the Abbott districts. Its program includes one preK teacher who runs half-day sessions for three different pre-K groups. As a non-Abbott district, South Bound Brook does not have preK master teachers.

There were, however, similarities in the preK curriculum models that were being used among the four districts. Half used *Creative Curriculum* (New Brunswick and Phillipsburg) and the other half *Tools of the Mind* (Bridgeton and South Bound Brook). Often in the meeting conversations, the feedback of other districts was solicited so that participants could gain knowledge on how to implement the block building activities within their curriculum models.

[12] Abbott districts are responsible for identifying and contracting with childcare centers that participate in the operation of their preK programs. The district is responsible for ensuring that childcare center providers adhere to certification, staffing, curriculum, and assessment requirements of the state.

District Team Composition

Across the four districts, there were 14 ECE participants who engaged in the professional development series, including six teachers, five master teachers, and three district-level early childhood administrators. Among participating teachers, the average length of teaching experience was nine years, and all but one held the P-3 certification issued by the state for early childhood education; one of the teachers also held a special education endorsement. Among the master teachers, the average length of teaching experience was 14 years and experience as a preK master teacher was four years. Three of the master teachers held a P-3 certification and one also held a special education endorsement. Of the three district-level administrators, the average length of teaching experience was 16 or more years with an average of nine years in administration. These administrators were certified in elementary education and one also held an endorsement in special education.

For the most part, each of the participating districts registered one team to participate in the ECE professional development series; New Brunswick registered two teams. As shown in Table 3, the composition of the district teams varied by site. The size of each team ranged between two and three people. All of the Abbott districts' teams included representation from master teachers, two Abbott districts included preK teachers on their team(s), and two Abbott districts included representation from the central office, via the EC Supervisor. The team from South Bound Brook (the non-Abbott district) included a lead teacher and a preK teacher, and was the only district team to include a kindergarten teacher. Within two of the Abbott districts, a third of the master teachers in the district participated and in one Abbott district, all of the master teachers participated. Participating preK teachers from the Abbott districts represented less than 5% of the preK teachers in their districts. In the non-Abbott district, one preK teacher participated, but represented a third of all preK teachers in the district.

Table 3
District Team Composition

District	Number of Teams	Team Composition	% of Master Teachers Participating	% of PreK Teachers Participating
Bridgeton	1	• EC Supervisor • Master Teacher • Two PreK Teachers	33.3%	4.1%
New Brunswick	2	• Two Master Teachers • Two PreK Teachers	33.3%	2.3%
Phillipsburg	1	• EC Supervisor • Two Master Teachers	100%	0%
So. Bound Brook	1	• Lead Teacher for Math and Science • PreK Teacher • Kindergarten Teacher	--[1]	33.3%
Total	**5**	**Total Participants = 14**		

[1]South Bound Brook does not have preK master teachers.

V. Implementation Rollout and Structure of the NJ MSP ECE Professional Development

The rollout of the ECE professional development plan was implemented through 10 full-day sessions to participating district teams, starting with the Summer 2005 Early Childhood Science Institute (July 11-15) and then five follow-up sessions scheduled over the course of the 2005-2006 school year. Between sessions, participating district team members implemented "homework" assignments in their district or classroom settings, received visitations and e-mails from the EC specialist, and had access to the NJ MSP website that included a link devoted to "Early Childhood Resources" that was updated on an ongoing basis. The "learning communities" professional development series culminated in the second annual NJ MSP Early Childhood Conference, co-sponsored by the NJDOE OECE, which took place in May 2006 and was open to early childhood educators throughout the state. The NJ MSP EC Specialist in conjunction with the NJ MSP Senior Science Specialist (who also served as a linking agent for the initiative), provided professional development during the follow-up sessions and facilitation during in-between session site visits, and additional providers or presenters participated in the science institute and the May conference.

Schedule and Structure of Professional Development Sessions

An overview of the Summer 2005 institute and follow-up sessions is provided below.

The Early Childhood Science Institute – Summer 2005 (July 11-15). Authors of the *Young Scientist* series introduced participating preK teacher/master teacher teams (and other invited guests from the NJDOE OECE and NJ MSP university staff) to the *Building Structures with Young Children* curriculum and each team was given the training set (which included the trainer's guide and video, and the teacher's guide). This curriculum package from the series became the instructional focus of the NJ MSP ECE professional development because it incorporated science and mathematics learning concepts and assimilated well with the existing preK curriculum models that were already being implemented.[13] As articulated in the professional development plan developed by the EC Specialist, this week-long summer institute would utilize presentations, readings, and hands-on activities, to familiarize participants with both themes or instructional goals to be reinforced throughout the professional development series and instructional strategies to implement the themes that were consistent with the research of Copley and Padron (1999) and the Reggio Emilia approach such as the following:

Themes/Goals

- Experiencing the ways forces such as gravity, compression, and tension affect a structure's stability;
- Learning how the characteristics of materials affect a structure's stability;
- Developing scientific dispositions including curiosity, eagerness to explore, and delight in being a builder; and
- Embedding math concepts into science learning experiences.

[13] It should be noted that each district team also received curriculum training sets for the other two parts of the *Young Scientist* series to take to their schools and utilize.

Instructional Strategies

- Encouraging science language, representational work and science literacy in the classroom;
- Developing strategies for documenting science learning; and
- Selecting and using materials for the classroom.

During the institute, EDC staff shared strategies on how to use an emergent curriculum technique of capitalizing on children's play and conversations to embed the exploration of concepts related to physical science and math. Participants engaged in several exercises that underscored the importance of creating a "culture of inquiry" that would gravitate students to interact with block materials (engage time); participate in "science talks" wherein they ask questions, make predictions, and share with others what they are doing with the block materials (explore time); and discuss what happened during their play with the block materials (reflect time). Multiple hands-on training experiences were used during the institute to familiarize participants with the different types of blocks used to promote two phases of science exploration that are used in ECE classrooms: 1) **Open Exploration**—getting familiar with materials, establishing a base of common experiences and vocabulary, and allowing children's interests and questions to emerge; and 2) **Focused Exploration**—a specific challenge or focus of block activity such as building a tower or building an enclosed space. In turn, participating district teams share their documentation panels of photographs, students' work, and students' comments that were generated from science-related classroom activities.

Also during this kick-off phase, the preK master teachers (and their counterparts from participating non-Abbott districts) received training in administration of the STERS by the assessment tool's designer, Ingrid Chalufour from EDC. A second round of STERS training was held in October 2005, and the initial round of STERS data collection was completed later that month.

Follow-Up Sessions (2005-2006 School Year). The follow-up sessions for district teams were full-day events implemented during the school day; again, sessions were open to invited members from the NJDOE and NJ MSP university staff. The sessions commenced in October 2005 and then occurred monthly through April. During each session, the NJ MSP Senior Science Specialist presented two-hour mini-lessons on science concepts relevant to block building. For the most part, discussion topics and activities for each of the professional development sessions included exploring science concepts, sharing classroom stories on the use of building blocks, discussions on students' work, and observed learning opportunities in science as documented in panels and through STERS. In addition, time was allocated for administrative items such as attendance, scheduling, and completing session evaluation forms. These activities enabled district teams to engage in ongoing investigation of science exploration concepts through discussions, readings, examinations of students' work, demonstrations of exemplary learning activities as provided through videos and live presentations, and hands-on learning scenarios.

Generally, these follow-up sessions provided participants the opportunity to share and reflect on their experiences and to discuss questions and ideas related to implementing the assignment from the previous session. Participants continually documented and examined students' work and other aspects of the science learning environment from their classrooms, including strategies

used to engage diverse populations as they pertained to gender differences, and ELL and special education students. Each participating district hosted a session so that opportunities for observing preK classrooms in action could be embedded (where possible) into the professional development. As the EC Specialist stated in the implementation plan, "Opportunities for reflection on practice and classroom visits will be incorporated into the sessions, providing the benefits of a long-term study group where networks of support develop over time. In addition, we want to discuss ways that teachers have tied together these science activities (with embedded math) to the state Preschool Teaching and Learning Expectations for science and math, as well as the curriculum models used by these [district] teams…" At the end of each session, participants would be given homework assignments centered on recommended readings and implementing new techniques and examining and documenting students' work.

- Session 1 (October 20 and November 2). The focus of the first session (one hosted in South Bound Brook and the other in Bridgeton) was on having each district team identify which element of the STERS they wanted to investigate deeply within their preK programs and would work on most to demonstrate improvement in that area by the end of the project year.[14] This teacher-as-researcher activity is consistent with the lesson study approach and encouraged participants to use the STERS, not as an evaluation process but as a tool for developing master teacher's (and classroom teacher's) capacity to understand how to improve science instruction. At this first follow-up session, each of the participants received a notebook binder with tabbed dividers to organize hard copy materials such as session agendas; participant contact information; classroom documentation forms for STERS, and master teacher logs; NJDOE core curriculum content standards, learning expectations, and preK master teacher job description guidelines; PowerPoint presentations and activity hand-outs used at training sessions; and numerous research articles, reference materials and resources related to best practices for early learning in math and science. Participants would update the binders with new materials obtained at each session and were encouraged to use the binder as part of their district's or center's internal teacher resource library.

- Session 2 (January 12). This session, which was hosted at Rutgers, focused on examining updated documentation panels of science learning that were emanating from district teams' preK classrooms. Participants discussed new strategies they were implementing with block building and successes and challenges of the process. Science content understanding was reinforced through a mini-lesson demonstration on building towers focusing on concepts of balance, stability, and friction. Participants discussed strategies to help build science vocabulary among ELL students using dual labeling, parent helpers, and language modeling.

- Session 3 (February 9). The session was hosted in South Bound Brook. The first half of this session convened classroom teachers together and master teachers with supervisors together in two separate groups for "sharing time" conversations related to changes observed in the classroom with regard to block building, students' interest in an interaction with blocks, math and science concepts being explored through block building, challenges encountered and mentoring provided to help teachers assist in their use of block building. A program specialist from the NJDOE OECE participated in the master teacher session. References to

[14] More information about the STERS goal-setting activity is presented in section VI.

reading and other resource materials contained in the resource binder were interjected throughout the discussion as a means for elaborating on what teachers and master teachers indicate they are doing, seeing or trying to achieve in the classroom. All participants then conducted informal classroom visitations to examine the environmental design, materials used and interactions among preK teachers and students. A mini-lesson on strategies to integrate more focused exploration in block building involved participants in hands-on scenarios and discussion. The proposed time for addressing participants' requests to develop ideas for translating new adult knowledge into classroom practice was postponed until the next session, due to time constraints.

- Session 4 (March 9). This session was hosted in Phillipsburg and focused on a semi-structured walk-through of the district's recently constructed early childhood learning center. Observations were conducted in several classrooms where students were engaged in group block building. Planning was then conducted on the organization of district teams' presentations at the early childhood education conference. In particular, participants were asked to review their initial documentation panels that they had brought to the science institute and discuss at the May conference the evolution of their classroom learning environment and students' work from that starting point to their more recent documentation panels. A mini-lesson on ways to engage students in making predictions and "science talk" discussions was reinforced through hands-on scenarios.

- Session 5 (March 29). This session was hosted at Rutgers and focused on having each district team present "their story" of accomplishments and lessons from the journey that emerged from participation in the NJ MSP ECE professional development series. Feedback on the stories was provided to help determine what aspects were most informative to share with others at the May conference.

May 2006 NJ MSP Early Childhood Education Conference. The NJ MSP Early Childhood Conference was entitled "*Under the Magnifying Glass: A Closer Look at Early Childhood Math and Science*" and featured presentations by a combination of expert researchers, university staff, and local practitioners of early childhood math and science and provided a state-wide forum for participating district teams from the NJ MSP ECE professional development series to share their experiences and research in incorporating math and science into the classroom. The conference was held on May 4, 2006, at The College of New Jersey in Ewing, NJ.

The keynote speaker for the event was **Alise Shafer**, director of the Evergreen Community School in Santa Monica, CA. Shafer's address to participants related to taking a closer look at children's construction of knowledge. She also conducted a breakout session that led participants through the creation of a "machine." The following seasoned ECE educators and researchers also conducted break-out sessions and participated in an expert panel discussion:

- **Ellen Frede**, Associate Professor, TCNJ; Co-Director, National Institute for Early Education Research
- **Carrie Lobman**, Associate Professor, Graduate School of Education, Rutgers University; Vygotsky educator and researcher

- **Sydney Schwartz**, Professor Emerita, Early Childhood, Queens College, CUNY; author, *Teaching Young Children Mathematics*[15]
- **Karen Worth**, Senior Scientist, Education Development Center; co-author, *Young Scientist* series

In addition, **Linda Clinard**, Director of the California Reading & Literature Project and **Debora Martin**, Early Childhood Consultant of the California Reading & Literature Project, from the MSP project at the University of California Irvine (UCI) presented FOCUS!/SMARTS. The purpose of the Faculty Outreach Collaborations Uniting Scientists, Students, and Schools (*FOCUS!)* partnership is to improve mathematics and science achievement in three high-need California school districts by uniting the efforts of mathematics, science, education, and research library faculty and staff with educators from local community colleges, educational support agencies, and school districts. The PreK Science, Mathematics and Reading Training Schools (SMARTS) Leadership Institute is a collaboration among UCI California Subject Matter Project (CSMP) leaders specializing in science, math, and literacy, working closely with PreK district leaders from three partnership districts.

Sharing the Journey presentations were conducted by district teams of preK teachers, master teachers and EC supervisors or teacher leaders who participated in the NJ MSP ECE professional development and/or the NJ SSI. The district teams involved in the NJ MSP ECE professional development (from New Brunswick, Bridgeton, South Bound Brook and Phillipsburg) shared examples and insights on their journey to incorporating more math and science concepts, using block building, into their preschool classrooms.[16] Each district team shared its perspectives on participation in NJ MSP professional development, children's explorations with blocks, children's documentation, its use of the STERS, and the mentoring process. The NJ MSP EC Specialist served as facilitator. Preschool teachers from Plainfield and New Brunswick who had engaged in the NJ SSI Lesson Study also shared how their learning community that developed through that process has strengthened their mathematical content knowledge and classroom practice. The Lesson Study presentation was facilitated by Kathleen Ferris, Project Coordinator for the Robert B. Davis Institute for Learning at Rutgers University.

Throughout the conference day, it was clear that participants alternated among sharing what they were already doing, generating new possibilities and exploring issues of application within their own contexts. Participants were spontaneously building on each other's ideas.

District Team Attendance

As shown in Table 4, nearly full attendance by members from the district teams was achieved throughout the professional development series. Each of the participating preK master teachers attended every event. Each of the 10 days of professional development that was offered through the series totaled seven hours, and participants received a certificate from Rutgers University documenting their attendance so that it could be counted towards the annual 30-hour professional

[15] Dr. Sydney Schwartz also served as a consultant to Metis Associates in carrying out the evaluation of the NJ MSP ECE professional development component.

[16] To prepare for this presentation, the district teams convened on March 29 and on the evening of May 3 for rehearsal meetings. A copy of their PowerPoint presentation at the conference is presented in Appendix J.

development requirement of the state. In total, the participating master teachers accumulated 77 hours of professional development and, on average, participating teachers accumulated 68 hours and EC supervisors or teacher leaders accumulated 58 hours.

It should be noted that program development specialists from the NJDOE OECE (who are responsible for planning and implementing state-sponsored preK master teacher training) attended several sessions within the professional development series. In addition, the professional development coordinator for the NJ State Systemic Initiative (SSI) at Rutgers University also attended a number of sessions.

Table 4
District Team Members' Professional Development Attendance

Team Members	Summer Institute[1]	Session 1		Session 2	Session 3	Session 4	Session 5	ECE May 4[1] Conference
		Oct 20	Nov 2	Jan 12[2]	Feb 9[1]	Mar 9	Mar 29[1]	
Teacher	7	4	2	5	5	3	5	4
Master Teacher	4	4	1	5	5	5	5	5
Supervisor/Lead Teacher	3	1	1	2	2	3	2	3
Total	**14**	**13**		**12**	**12**	**11**	**12**	**12**

[1]These sessions were attended by OECE program development specialists and NJ SSI staff.
[2]This session was attended by NJ SSI staff.

It should be noted that overall attendance at the science institute and May 2004 ECE conference was much greater than the number of people who attended from the participating district teams. The July 2005 science institute, which included the Vineland school district and other invited guests, had a total of 32 attendees. The May 2006 conference had a total participant count of 149, representing 29 New Jersey school districts. Districts with the greatest number of participants at the conference were New Brunswick (28, accounting for 19.4% of total participants), Plainfield (33, accounting for 16.0%), and Trenton (11, accounting for 7.6%).

Table 5 shows the number and percentage of participants at the May conference by staff level. Teachers were the most prevalent group at the conference, representing nearly 38.9% of the attendees. Master teachers also comprised more than a quarter of the participants. The remaining attendees served a variety of roles including NJDOE program specialists, District Supervisors, center directors, aides, program coordinators, higher-education faculty, students, and such liaisons to the classroom.

Table 5
Number of NJ ECE May 2006
Conference Participants by Staff Level

Staff Level	N (%)
Teachers	56 (37.6%)
Master Teachers	39 (26.2%)
District Supervisors	6 (4.0%)
Center Directors	5 (3.4%)
Other	18 (12.0%)
Unknown	25 (17.7%)
Total	**149**

Participant Feedback on the ECE Professional Development Series

At the end of each event in the professional series, participants were asked to provide feedback on the various segments of the professional development session, by rating the quality of the session and their level of interest in learning more about the topics discussed in that session. Respondents were given a five-point scale, with "1" indicating low quality or interest and "5" indicating high quality or interest.

Session-Quality Ratings. Table 6 shows aggregate mean ratings on the quality of the information and presentation of professional development topics that were discussed at each event in the series as assessed by attendees.[17] Professional development attendees perceived the information and presentation of topics at each event to be of high quality as indicated by the overall quality rating of 4.62. The professional development events that received the highest overall mean ratings were the January, February, and March follow-up sessions (with mean ratings of 4.91, 4.89, and 5.00, respectively). It is important to note that these sessions included opportunities for first-hand and in-depth observation or examination of students' interactions and work through such activities as classroom visits and reviews of teachers' documentation panels. The March follow-up session, in particular, engaged participants in a focused, reflective dialogue of how their knowledge and understandings had expanded or changed and the utility of the professional development was made evident through this exchange. The May 2006 ECE conference received a much lower mean rating (3.78) than other events; in large part, this may be due to: (1) the difference in the make-up of attendees, which included a majority of professionals who were being exposed to a range of science and mathematics curriculum ideas for the first time, and (2) technical glitches (malfunctioning audio and video equipment) in several of the presentations that limited the clarity of the presentation content. As Table 7 shows, in terms of their level of interest in learning more about session topics presented in the professional development series, attendees overall indicated a "high" level of interest (4.66).

[17] For a detailed presentation of the distribution of quality ratings given to each agenda item presented within the series, see Appendix K.

Table 6
Quality Ratings of Professional Development Sessions

Professional Development Event[1]	Total Agenda Items	Mean[2] Respondents	Mean Rating
Early Childhood Science Institute (Rutgers)	12	14.69	4.62
October Follow-up I (South Bound Brook/Bridgeton)	4	12.50	4.54
January Follow-up II (Rutgers)	3	8.33	4.91
February Follow-up III (South Bound Brook)	4	7.00	4.89
March Follow-up IV (Phillipsburg)	4	7.00	5.00
May ECE Conference (TCNJ)	7	97.3	3.78
Overall	--	--	**4.62**

[1]At the final follow-up session (March 29), participant reflection forms were completed instead of session evaluation forms.
[2]Mean respondents represent the average number of session participants who provided a quality rating for each agenda topic presented at that professional development session or event.

Table 7
Interest Level Ratings of Professional Development Sessions

Professional Development Event	Total Agenda Items	Mean[1] Respondents	Mean Rating
Early Childhood Science Institute (Rutgers)	12	14.1	4.71
October Follow-up I (South Bound Brook/Bridgeton)	4	11.5	4.63
January Follow-up II (Rutgers)	3	9.33	5.00
February Follow-up III (South Bound Brook)	4	8.75	4.81
March Follow-up IV (Phillipsburg)	4	4.00	4.96
May ECE Conference (TCNJ)	7	90.57	3.84
Overall	--	--	**4.66**

[1]Mean respondents represent the average number of session participants who provided an interest level rating for each agenda topic presented at that professional development session or event.

Learning Community Follow-up Session Structure and Content Ratings. To a great extent, the structure and content of the learning community follow-up sessions consisted of the same four elements: (1) time for administrative items or "checking in" discussions; (2) stories from the classroom such as sharing time and classroom visits; (3) discussions about data collection such as documentation panels, master teacher logs, and STERS; and (4) exploring science concepts through hands-on scenarios with the NJ MSP Senior Science Specialist. At the end of each follow-up session (using the same five-point scale mentioned previously), attendees were asked to rate the quality of information and presentation of topics discussed in each of the four elements. Table 8 shows the mean ratings (from four follow-up sessions) that were generated

from the ratings received at each session for each element.[18] Overall, participants of the learning community follow-up sessions rated each element quite high.

Table 8
Quality Ratings of the Structure and Content of Follow-Up Sessions

Learning Community Elements	Mean[1] Respondents	Mean Rating
Checking In	8.67	4.89
Stories from the Classroom	9.6	4.81
Data Collection Discussion	10	4.70
Exploring Science Concepts	9.25	4.88

[1]Mean respondents represent the average number of session participants who provided a quality rating for each segment area of the follow-up professional development sessions, across professional development sessions.

Examples of comments from district team members on each of these elements are provided below.

- Checking In Activities. This element of the follow-up sessions served as the warm-up for each convening of the learning community and gave participants an understanding of the structure and purpose of the day's session. Participants' comments in this regard include: "it caught us up on housekeeping issues….[it]got my dates organized….[the] logistical review helps me know where I am….It was nice to have check in items listed on agenda ahead of time….Requirements of PowerPoint were helpful. Thanks for reminding me to read the books!"

- Sharing Stories from the Classroom. This element provided opportunities for classroom visitations in a variety of settings (given the diverse size and populations of preK programs across the participating districts) to explore the use of block building within the framework of different preK curriculum programs. Participant comments regarding sharing activities include: "I think sharing is so important as it validates and opens doors for future learning….[It is] great to see how another curriculum is integrating building structures….Classrooms are laboratories in action! The applied setting is valuable…. It's always interesting to share and compare. I find it really keeps me on track… Always something to learn from seeing how others do things…. Sharing is informative and exciting and bonding experience." Sharing discussions provoked conversations on issues around generating girls' interest in block building, strategies for ELL students, and how to keep structures up for extended periods.

- Data Collection Discussions. This element of the follow-up sessions focused learning community participants on processes used to collect data on the quality of the science learning environment in preK classrooms. Discussion during this element centered on processes for developing documentation panels, maintaining logs, conducting STERS observations, and reflecting on data emanating from these efforts. Since the aspect of assessing the quality of science learning was probably the least familiar to district teams at

[18] For a detailed presentation of the mean ratings given for each element at each session, see Appendix L.

the start of the professional development series, it presented the most challenges, as the following comments from participants indicate: "This seems like the most vital part of the entire program, and also the most difficult….[It was] overwhelming at first…[I] need time to digest [the] forms and how [I] will use it….This is an area our school is weak in, we need to collect data and learn to interpret it frequently." With regard to documentation panels, participants expressed more ease in their ability to assess changes that were captured through the process: "I liked comparing documentation from summer to now and evaluating based on what we know now….Feedback forms with summer [documentation] panels were very helpful! Reassured me of my progress…. Our science of block play has really grown since [the] summer….[It's] Amazing to see our panels from the summer and how far we've come."

- Exploring Science Concepts: This element, in which the NJ MSP Senior Science Specialist exposed participants to science content knowledge through hands-on experiences with block building, was one of the highest rated elements of the learning community. Participants' comments provide even more evidence of their enthusiasm for and appreciation of these sessions: " Great! I got a chance to be a student in order to better help my students….[It is a] Good mix of lecture and hands-on demonstration….Identifying the "big ideas" is helpful. I have gaps in my science understanding….My understanding and ability to use scientific terms needs strengthening." Participants also noted how much they learned as part of having the opportunity to explore science concepts: "[I've] Learned many new concepts and ways to use them….[I] Will use some of [the] lessons: stability, center of gravity, [and] slippery….I always learn a lot from [the presenter] and get excited to try new ideas in classroom."

Participant Feedback on the May ECE Conference

The May 2006 ECE conference provided the opportunity for the "learning community" of district teams to present their work with the NJ MSP ECE component to peers across the state. Over 100 ECE educators attended the conference: they were asked to rate the quality of the conference sessions they attended and their level of interest in learning more about the topics presented in each of those session. Again, respondents were given a five-point rating scale, with "1" meaning low quality or interest and "5" meaning high quality or interest.

As shown in Table 9, of all the general sessions that were presented at the conference, the *Sharing the Journey* session by district teams that participated in the NJ MSP ECE professional development series received the highest mean rating from conference attendees for both the quality of the session (4.15) and the level of interest in learning more about topics discussed during the session (4.23). The majority of the comments (N=25) received from participants on the presentation indicated that they thought the presentation was "excellent," "well-organized," and presented "good ideas" about opportunities for science learning. Examples of feedback comments include the following: "Excellent presentation style used to bring a lot of projects to life. It is great to see the outcomes of projects….Good ideas and incentive to follow up in classroom….[It] Proved that teachers can do it! One of the best today….[The presentation] should be used for an in district workshop, [teachers are] always looking for different ways to expand exploration in the block area….I learned that math and science are a big part of blocks." Some attendees (N=7) provided recommendations to improve this type of presentation in the future: "There was good info, but the delivery of information could have been more lively

instead of just 'reporting'. Once the different participants began to share it was much more interesting….[I] would've liked more hands-on workshop style instead of lecture….We need specific ways to implement science/math into lessons. [I] would like more practical/useable lessons/techniques. There was too much of the lecture and not enough hands-on activities." Note that the interest in more "hands-on" activities reflects the large number of participants who did not have the benefit of the NJ MSP EC professional development experiences and were hearing about complex curriculum ideas for the first time.

Table 9
Quality and Interest Level Ratings
of ECE Conference Sessions

Quality Ratings			Interest Level Ratings		
Conference Session	**Total Respondents**	**Mean Rating**	**Conference Session**	**Total Respondents**	**Mean Rating**
Keynote	113	4.12	Keynote	104	4.16
Sharing the Journey I – Lesson Study	106	3.19	Sharing the Journey I – Lesson Study	100	3.44
California's MSP	97	3.40	California's MSP	91	3.32
Sharing the Journey II – MSP	**97**	**4.15**	**Sharing the Journey II – MSP**	**92**	**4.23**
Report Out	86	3.45	Report Out	79	3.51
Panel of Experts	76	3.78	Panel of Experts	68	3.81
Breakout Sessions	106	4.38	Breakout Sessions	100	4.43

VI. Progress Made and Challenges Encountered in Meeting the ECE Professional Development Objectives

As mentioned previously, the overall goal of the NJ MSP ECE was to improve the expertise of early childhood educators as evidenced in the quantity and quality of math and science classroom learning experiences. To accomplish this, the ECE professional development series was designed to improve teachers' knowledge base in the exploration of math and science concepts, to improve teachers' dispositions toward math and science, and to equip teachers with strategies to assess and support the translation of science content into the learning environment. This section of the report presents analyses of data that were used to document and assess progress and implementation challenges encountered in attaining desired outcomes. The discussion is organized under the three professional development objectives.

Improving the Knowledge Base of Teachers in Exploring Math and Science Concepts

Three lead aspects of the NJ MSP ECE professional development series served to promote and strengthen teachers' knowledge base of science concepts associated with early learning in math and science. These were as follows:

(1) the "Building Structures with Young Children" curriculum tool from EDC's *Young Scientist* series, which provided an implementation framework for deepening teachers content knowledge;
(2) the EC Resources Binder that was generated for each participant using numerous reference materials on "big ideas" in science and best practices for science inquiry with early learners that were distributed, read, and discussed by participants and session facilitators throughout the professional development series; and
(3) the ongoing, hands-on science learning with block building simulations that were facilitated by the NJ MSP Senior Science Specialist at each follow-up session (except the first session).

Phone interviews that were conducted at the end of the project with EC supervisors and teacher leaders from the participating districts (discussions that, in some cases, included master teachers) indicate that these aspects of the professional development series were well received.[19] One master teacher indicated that the curriculum and resource materials were referred to during the school year and would likely be used again in the future. One EC supervisor reported that the *Young Scientist* "teacher edition was clear and direct." Another indicated that "The trainers' materials will be helpful for us to give a workshop and know what we're talking about. Especially having gone through the training, I think that it is invaluable." One supervisor said the curriculum and resource materials were not useful to her ("I have not had time to sit down and read through the materials"), but that "teachers use it and find it helpful."

Generally, interview respondents perceived the workshop facilitators to be very knowledgeable in their use and implementation of the hands-on aspects of the trainings. Comments from one EC supervisor best captures this sentiment.

> *…I think [the Senior Science Specialist] increased our own knowledge about block blocking and science. Not so much about what we can do with the kids, but the center-of-balance and gravity information because teachers need a higher science concept knowledge base in order to bring these concepts to the preschoolers' level. I think that's why teachers don't want to teach math and science [to their students], because we don't know enough about the content. [The specialist] actually increased our content knowledge so that we can structure experiences for children where they can learn a lot more.*

One of the methods used in this pilot project to assess the extent to which the ECE professional development had served to improve teachers' knowledge base for exploring math and science concepts was a pre/post questionnaire that was administered to all participants present at the beginning and at the end of the summer science institute.[20] Items on the questionnaire that

[19] In the three participating Abbott districts, the EC Supervisor and the master teacher participated in these interviews, and in the non-Abbott district, the lead teacher for math and science participated.
[20] The pre/post questionnaire consisted of four items (three open-ended and one close-ended) related to the following topics: (1) the important elements of an early childhood science program, (2) how decisions are made about the inclusion of science content, (3) how science learning is assessed, and (4) how often science learning experiences and/or conversations with children are conducted in a typical week. Twenty-seven pre-questionnaires and 21 post-questionnaires were received. Content analyses of open-ended items were conducted to reveal common categories of responses. Descriptive statistics were used to analyze data from the close-ended item. Detailed results of the pre/post-questionnaire are presented in Appendix B.

related specifically to understanding the participants' knowledge base about ways to explore science concepts included the following:

- Describe the important elements of a science program for young children.
- How do you decide on the science content to include in your program?

Important Elements of Science for Young Children. On both the pre- and post-administrations of the questionnaire, respondents' descriptions of the important elements of science to address with early learners fell into the following five categories:

- **Curriculum and pedagogical components** included descriptions of concepts (i.e., nature, living things, children's interests, senses, general age-appropriateness), the level of teachers' knowledge and preparedness, specific instructional strategies (i.e., use of science centers, grouping strategies, the integration of science into other content areas), and children's vocabulary and ideas.
- **Hands-on references** included all comments that mentioned "hands-on" activities, games, and experiences.
- **Inquiry skills** included references to and all forms of the following terms: question, interest, inquiry, discovery, curiosity, imagination, represent, document, engage, explore, and reflect.
- The **scientific method** category included terms often associated with science teaching and learning (i.e., predict, experiment, observe, focus, problem solve, hypothesize, discuss, record, investigate, conclude, manipulate, test) that do not necessarily lend themselves to an inquiry-based approach to science teaching.
- The **materials** category was comprised of any references to specific and general use, and availability of materials for exploration (i.e., magnifying lenses, plants, fish, trees, soil, water).

Figure 1 provides a graphic depiction of the differences from the pre- to posttest in the frequency of use of terminology or references assigned under each of the identified categories as extracted from science institute participants' descriptions of the important elements of science in early learning. As shown in Figure 1 and Table 10, science institute participants' pre-test descriptions of important elements of EC science programs were split fairly evenly between the inquiry and scientific method skills categories, with nearly a third of the references included in their descriptions attributed to each. At posttest however, three quarters of the responses identified inquiry skills as important elements, indicating an increase of about 45 percentage points. At post-test, only about 10% of the references in respondents' descriptions identified scientific method skills as important, reflecting a decline of about 24 percentage points. For example, one teacher's pre- and post-questionnaire response to this item changed from:

A science program should teach pertinent content info while providing students an opportunity to build skills in observation, questioning, hypothesizing, experimenting and even journal keeping.

to

A science program needs to give students the opportunity to engage and experiment with materials, explore and develop question[s]*, and reflect to gain insights on what they've done.*

Figure 1
Pre/Post Questionnaire Response Differences in Identified Important Elements of an EC Science Program

Table 10
Pre/Post Questionnaire Response Differences in Identified Important Elements of an EC Science Program

Science Element Category	Pretest (N=27)		Posttest (N=21)	
	N References	%	N References	%
Curriculum Components	19	17.4%	8	8.8%
Hands-on References	10	9.2%	4	4.4%
Inquiry Skills	34	31.2%	69	75.8%
Scientific Method Skills	37	33.9%	9	9.9%
Materials	9	8.3%	1	1.1%
Total	**109**	--	**91**	--

How Decisions are Made About Science Content to Address with Young Children.
Participants' descriptions about how they decide on the science content to include in their preK programs were synthesized into the following five categories:

- **Children's interest and developmentally appropriate content** included references to children's interests, questions, or curiosity, as well as references to developmentally appropriate content.
- **Curricular and administrative input** included references to the influence of the curriculum, curricular themes, master teachers' and/or EC supervisors' input, the NJ Teaching and Learning Expectations, the integration of content areas, and hands-on materials.
- **Teachers' decision** included responses explicitly stating that they (as teachers) decide upon based on their interests, comfort and knowledge levels, and past experiences.
- **Research-based** included references to using research on early childhood learning to inform the decision-making process.

- **Environment and time of year** included references to using seasonal changes, the time of year, or the surrounding environment.

The differences from pre- to post-questionnaire in the frequency of use in terminology or references assigned under each of the identified categories are presented in Figure 2 and Table 11. Overall, there was some variation in institute participants' pre- and post-test accounts of how decisions are made about the science content to include in their preK programs. At pre-test, 40% of references in the responses provided alluded to making science program decisions based on children's interests, compared to more than half of the references (55.3%) at posttest, an increase of about 15 percentage points from pre-test. At pretest, more than a third of references (34.5%) identified the input of districts' adopted preK curriculum program, master teachers, and supervisors, and/or the NJ *Teaching and Learning Expectations* that influenced the decision-making process compared to 13.2% at post-test, a decrease of about 21 percentage points. **None of the pretest responses referenced direct linkages to current research on early childhood science learning.** At post-test, two references in response to this item included the consideration of current research when deciding on science content to include in their programs. The following is one reason why the NJ MSP EC Specialist emphasized the creation, distribution, and ongoing utilization of the "resource binder" during the professional development follow-up sessions: "I developed a growing list of mathematics and science reference materials and resources to which [the learning community] could refer at our sessions….[The binder] represents a body of work that is very important to advancing the cause of mathematics and science teaching in prekindergarten….Referring to resource materials during [each session] helped reinforce the ideas being developed." Comments from learning community participants about the binders indicate that they were viewed as useful because of the "written resources to share and read," that it "helped to keep [teachers] organized," and that it contained "digital photos of all the [learning community] participants along with their bios, which made it really easy to get to know everyone." Two participants complained that the size and weight of the binder made it cumbersome to use.

Figure 2
Pre/Post Questionnaire Response Differences in Identified Influences on the Science Content Included in PreK Programs

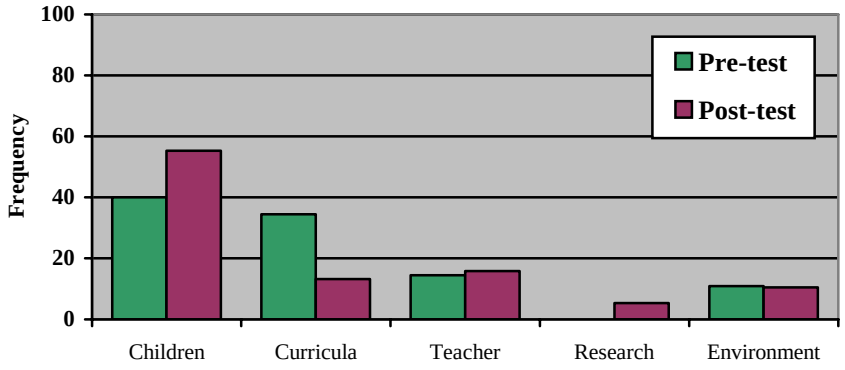


Table 11
Pre/Post Questionnaire Response Differences in
Identified Influences on the Science Content Included in PreK Programs

Decision-Making Influence Category	Pre-test (N=26)		Post-test (N=21)	
	N References	%	N References	%
Children's Interest/ Developmentally Appropriate Content	22	40.0%	21	55.3%
Curricular/Administrative Input	19	34.5%	5	13.2%
Teachers' Decision	8	14.5%	6	15.8%
Research	0	0.0%	2	5.3%
Environment/Time of Year	6	10.9%	4	10.5%
Total	**55**	--	**38**	--

Another method that was used to gauge teachers' knowledge base in exploring science concepts was the "Research Goal-Setting Form" that was completed by teachers (and signed by their master teacher and/or supervisor or teacher leader). Using this form, teachers identified the area of science teaching and learning in which they wanted to improve in or investigate more deeply over the course of the professional development series. Within their selected area, teachers had to identify resources needed[21] and at least one goal that could be documented when achieved. The identified area had to align with one of the STERS domains (physical environment, hands-on exploration, representation, oral and written language of science inquiry, science talks, planning for in-depth investigations, and assessing science learning).

Five goal-setting forms were completed for the six teachers who participated in the professional development series; four teachers completed an individual form and two teachers, from one of the districts, identified shared goals on one form. Among this group of teachers, the following STERS domains and focal areas of investigation were identified:

<u>Physical Environment</u>
- Incorporating the use of more diverse materials
- Increasing the area for science
- Expanding the block area

<u>Hands-On Exploration</u>
- Offering a variety of building materials as well as items/books that will lead to investigations and hands-on involvement.

<u>Oral and Written Language of Science Inquiry</u>
- Using new and descriptive language including mathematical terms and encouraging representation

[21] Teachers used a standardized process to identify the resources needed in their classrooms in order to address their identified goal area. The process utilized a "classroom environment checklist" form that listed the various types of building blocks that are needed to implement the science exploration and inquiry learning environment exposed in the *Building Structures* curriculum model.

Science Talks
- Supporting science concept learning in the block area of an inclusion class for three-year-olds class.
- Introducing interaction/cause and effect

Specific goals to be achieved by teachers through these investigations were cited in the areas of:
- Language/Vocabulary (N = 3)
- Representation/Documentation (N = 3)
- Materials (N = 2)
- Exploration/Inquiry (N = 2)

Comments gathered at the final follow-up session through the reflection forms[22] that were completed by teachers and master teachers indicate that participants perceived that progress had been made in improving science teaching and learning in the targeted areas through the use of building blocks. As one teacher commented, "I used to think that my job was just to keep the kids from hitting each other with blocks. Now I know how much can actually be taught and learned in the block area." A similar comment came from a master teacher: "[I have] become more aware of science concepts in the block area and saw [the] value of using different types of blocks with one structure."

> *Girls were building horizontally vs. vertically in the beginning. Towards the end of the fall, they were building taller structures and were proud of themselves. They came up with ideas of using chairs/ladder to build taller structures. Less social children were able to show [their] peers their creations in block building and share ideas. Math and science traditionally are male dominated. Areas are being explored by females…[this is] empowering girls to go into nontraditional areas.*
>
> —PreK teacher participant

Master teachers commented that their participation in the science institute and follow-up sessions had influenced their feelings about math and science, and their strategies for supporting teachers' introduction and discussions about new science concepts. Examples of comments from master teachers in this regard include the following: "I am more willing for teachers to gain outside experiences (via workshops, colleague talks) in order to learn new concepts and implement them in [the] classroom. I plan to develop workshops for teachers to gain a greater understanding of our learning….[Teachers and I are] collaborating more on what the next steps in focusing on concepts that are introduced to children [are]…."I brought up new concepts including direct instruction using science terms and identifying science concepts during focused explorations….I now look for science concepts to introduce into other areas and scaffold teachers on how to bring math and science into block play (language and concepts)." In addition, one supervisor commented, "I am more aware of the true nature, benefit and advantages of block building with a focused exploration. I can now begin to create sessions to share the strategies with other teachers and admin[istrators]."

> *Prior to our involvement with MSP, the block area was a social area, but now it's more purposeful.*
>
> —EC Supervisor

[22] A total of 11 reflection forms were completed representing five master teachers, five teachers, and one EC supervisor. Open-ended comments obtained from the forms were summarized.

Participating preK teachers also described the kinds of student interactions with building blocks and with each other that had started to emerge in their classrooms as a result of the implementation of professional development strategies.

> *Children are spending longer periods of time in the block area. At first, they were building simple towers. Now, the towers are more complex and [students] are also building enclosures.*
>
> *In September and October, [students] were mostly building roads. In November and December, I encouraged building towers and open enclosures and garages. In December and January, they were building towers and structures with decorative balanced blocks. We referred to the [Young Scientist] building books, asking, "How do we make this?"*
>
> *Students are doing much more elaborate and cooperative block building. I've also noticed that they are tying building into other lessons we've covered.*
>
> *Children's buildings are becoming more involved and they are able to sustain interest for longer period of time.*
>
> *In addition to participating in 'assigned' group block building, more students are carrying building activities into choice time. I finding they are also using [a] more varied assortment of building materials in more elaborate ways.*

The NJ MSP EC Specialist observed progress in meeting this professional development objective as well, stating, "In retrospect, I see that all participants moved forward in their understandings of how to bring science in the block area."

Improving Teachers' Dispositions Towards Math and Science, and Helping Them to Translate Content to the Targeted Age Group

Lead aspects of the NJ MSP ECE professional development series that served to improve teachers' dispositions towards math and science learning and helped them to translate content to the targeted group included:

(1) the "learning community" approach to professional development that enabled teachers' ongoing opportunities to share information with colleagues within and across districts, and
(2) the in-between session homework assignments that provided non-threatening encouragement to teachers to set goals, try new strategies, and document students' work as a way of examining science learning in their classrooms.

Feedback from interviews conducted with EC supervisors and teacher leaders indicate that information sharing and exchanges that took place within the learning community were perhaps the most enjoyable and informative aspects of the follow-up sessions. One supervisor indicated that the "collaborative atmosphere provided practical support and inspiration," while another

agreed that it was "good to see how other people are doing it." Another agreed that it was very important to "actually go to the schools and see what the other teachers were doing and be in their environment." The EC Specialist viewed the documentation panel homework assignments as a key strategy in promoting teachers' confidence in translating science concepts to children, "Engaging teachers in documenting children's work led to the expectation that everybody—all the participants—were learning as professionals and they became increasingly active in professional development sessions and as classroom researchers."

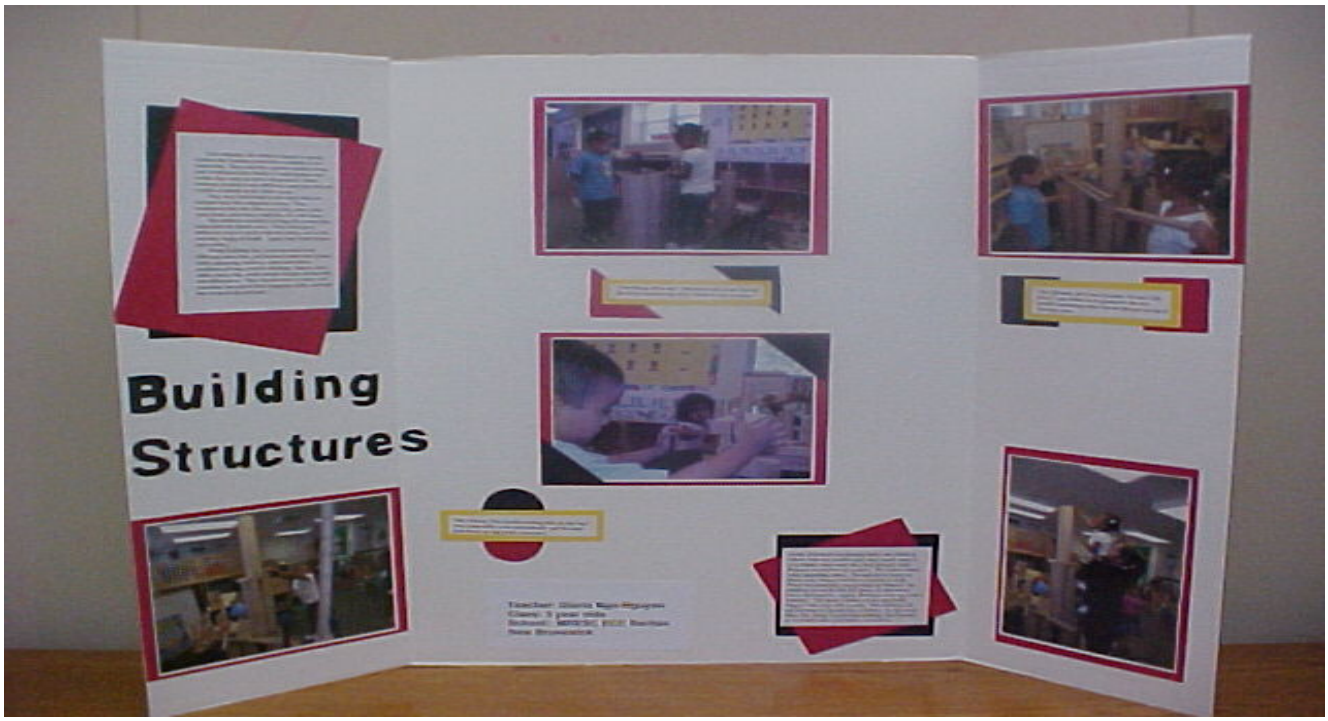
> *We were all being able to share experiences, challenges, and successes. I think that those follow-up sessions were paramount to the success of the program.*
>
> —EC Supervisor

Comments from the district interviews related to the homework assignments of generating documentation panels and collecting representations of students' work were also very positive. One district team reported that "Documentation panels and photos changed the classroom environment, connected children with learning, and increased communication between parents and staff". Another district team agreed, "It helped teachers reflect on what they were doing, made [professional development] more rewarding and makes you want to do it more because you can see what's going on [and] you can see the growth." One teacher reported use of the documentation panels to engage parent involvement in and understanding of the preK learning program. Another supervisor mentioned that documentation panels have "become part of the classroom routine…[because] you see exactly what the kids have done." That said, one district did find it challenging to find time to complete the homework assignments. A member of this district team reported, "I think that [documentation panels] were helpful but very time-consuming. Teachers, in general, are very overwhelmed. I think they produced some anxiety. Sometimes I was able to get them some coverage so that they could work on the documentation panels, but I know that every administrator is not doing that." Photos of some of the documentation panels generated by participating teachers and representations produced by students are presented on the next page.

> *Teachers felt they were able to more effectively and efficiently document children's science learning and work using the digital camera and quotes from the children with anecdotal notes.*
>
> —NJ MSP EC Specialist

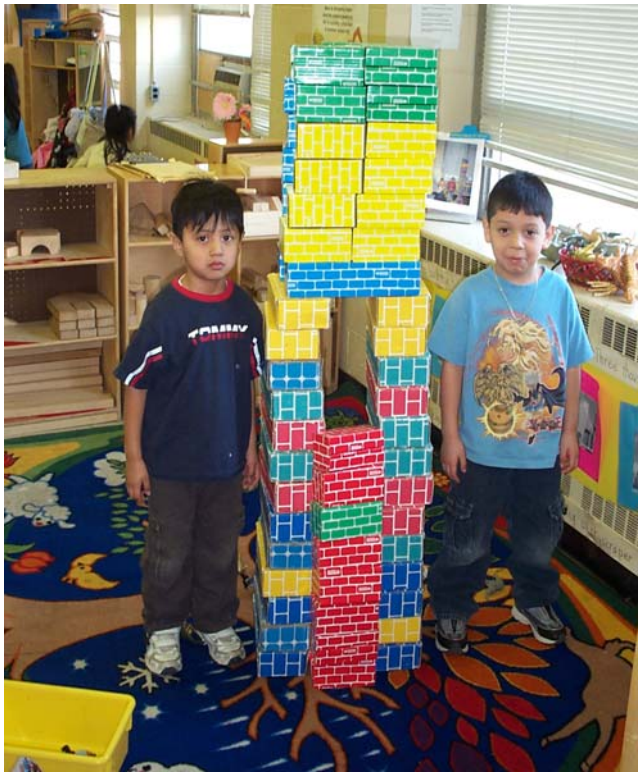
During "sharing time" segments of the NJ ECE professional development follow-up sessions, preK teachers reported that they had become more adept at posing questions during block play that moved children's conversations to a deeper level of science inquiry. Such questions reported by teachers included:

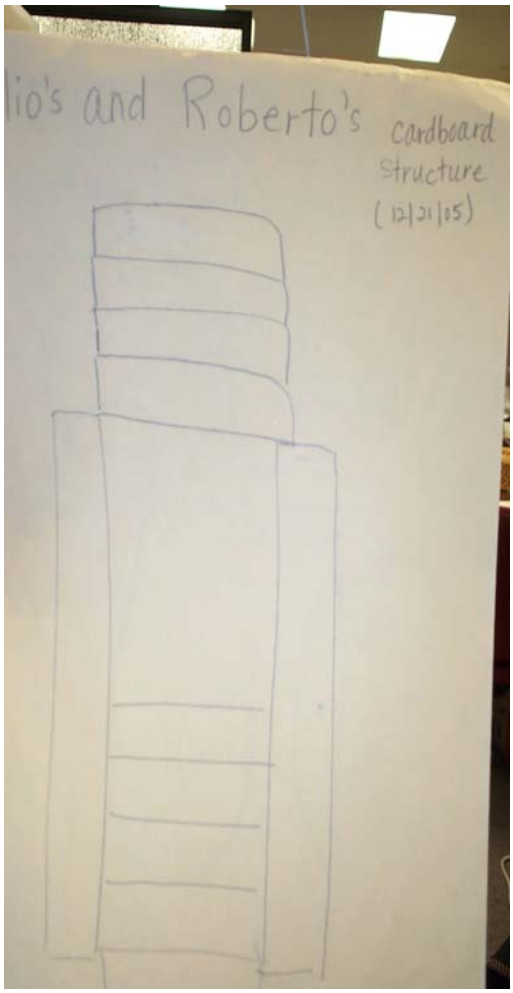
Why do you think the structure that you built collapses or falls?
What types of blocks will make the tallest building and why?
Why did this structure fall? What could you do differently to keep it from falling?
Which shapes will work for your building and why?


Building
Structures


Bridgeton Public Schools
Early Childhood Program
KIDS AT WORK
KIDS AT WORK
KIDS AT WORK
KIDS AT WORK
KIDS AT WORK
KIDS AT WORK


Liam




lio's and Roberto's cardboard structure
(12/21/05)

Additional preK teachers' comments, as provided on their reflection forms, further demonstrate that the ECE professional development series was successful in improving teachers' dispositions towards and confidence about promoting science learning with children. Below is a sample of comments in this regard.

> *I'm not "science or math phobic" any more! I know now that math and science concepts can be taught through what I previously considered play!*
>
> *I have totally changed the way I introduce science concepts in the classroom. [I introduce] concepts with books poster..[by]Listing concepts that we are going to introduce in science and block center…[and by] Listening to other people's ideas and trying to incorporate them in some way in [the] classroom [discussion].*
>
> *I am much more aware—I plan and add science concepts where I didn't before.*
>
> *We spend a lot more time and focus on exploring science concepts. Sometimes books are used as an introduction as well as photographs/neighborhood walks. Children are encouraged to explore, document, and make connection to science concepts and math.*

Participants of the learning community also cited challenges in meeting the commitment of completing the homework assignments that provided information for the healthy exchange of experiences and ideas discussed at a professional development session. Challenges to implementation that were mentioned included time constraints, limited materials, difficulty in integrating science content, language barriers in the classroom, and support of the administration. The most frequently cited concern was lack of time, including planning time with master teachers, time to complete learning community assignments, and time for science within a prescribed curriculum. The NJ MSP EC Specialist cited similar concerns: "The geographical constraints affecting time travel limited the availability of off-site professional development time and therefore the progress we could make toward goals." With regard to challenges encountered in implementing science inquiry strategies, one EC supervisor stated: "[I'm] Trying to encourage staff to think intentionally about block play. [However,] I found that while I continually encouraged it, it wasn't so easy to do when I tried it myself." A master teacher agreed that, "My challenge was trying to keep the teacher adequately informed about what I was learning in order to implement science goals with blocks, without overwhelming her."

Equipping Teachers with Strategies to Assess and Support the Translation of Science Content into the Learning Environment

The aspects of the NJ MSP ECE professional development that served primarily to strengthen teachers' capacity to assess and support the quality of the environment for science learning in preK classrooms are listed below.

(1) The STERS was used to help master teachers and classroom teachers document and describe the environment for and quality of science teaching in the classroom; within the NJ MSP ECE professional development series, the focus of STERS data

collection focused on documenting the available materials, their organization, and application to support science learning activities within the block area.

(2) Master teacher logs were used to document how preK master teachers were helping classroom teachers to plan strategies that would continue and enhance the focus of science learning in the block area. It was one of the vehicles used to extend the ECE professional development focus into the school setting.

Feedback from the district interviews suggests that participants of the professional development liked that the STERS provided an objective process for looking at indicators of science learning. One EC supervisor reported that, "The STERS assessed what was needed in the classroom and probably helped my [master teacher] think about how [to] facilitate [STERS components] being there." A master teacher reported: "[The STERS] drove the whole project and was probably the most important piece…" As mentioned earlier in the report, the NJ MSP identified the need for master teachers to receive training in and access to such a tool, given that current assessments being used in Abbott preK classrooms focus primarily on measuring the quality of the environment for learning in literacy and math.

Data collected through the pre/post questionnaire that was administered to participants at the beginning and end of the ECE summer science institute also reinforced the need to equip master teachers with a valid and reliable process for assessing science learning in ways that would inform the instructional planning and coaching activities conducted with teachers. To understand what methods master teachers and teachers had been using to examine science learning in the classroom environment, the questionnaire asked "What do you look for to determine what science learning the children have achieved?"

Strategies Used in Determining Science Learning. Responses to this questionnaire item were content analyzed, producing five categories as listed below.

- **Children's language** included all references to children's use of language (i.e., answers to questions, group sharing, class discussions, reflections, explanations of phenomena).
- **Children's interest** included references to the child's interest in science learning, including the questions asked by the child, their investigations, enthusiasm, sharing knowledge with others, and application of knowledge to other activities.
- **Teachers' observations** included references to the use of photographs or videos and anecdotal record-keeping, as well as children's behaviors that would need to be observed (i.e., engagement, exploration, testing, experimentation, the frequency of science material use).
- **Documentation and representation** included references to the review and assessment of students' work, such as documentation panels, children's representations, drawings, portfolios, and journals.
- **The Early Childhood Environment Rating Scale (ECERS)** included any reference made to the state-mandated observation tool that is administered annually in Abbott preK classrooms to assess the quality of learning environment factors such as space and furnishings, routines, activities and interactions, program structure and parents and staff.

Figure 3 depicts and Table 12 details the pre/post differences in the frequency of references that appeared in participants' questionnaire responses under each category of methods used to determine science learning. At pretest, the most commonly cited methods by professional development participants were observations (37.1%), students' interests (22.6%), and children's language (19.4%); the least cited methods were documentation and representation (16.1%) and ECERS (4.8%). By the end of the summer science institute, documentation and representation became as frequently cited as classroom observations as the method used to assess science learning. While the percentage of references to observations was relatively the same from pre-to posttest (from 37.1% to 32.8%), the percentage for documentation and representation notably increased by 17 percentage points (from 16.1% to 32.8%). The method of using children's language slightly increased (from 19.4% to 23.0%) and the use of children's interest decreased from 22.6% to 11.5% (a drop of 11 percentage points).

Figure 3
Pre/Post Questionnaire Response Differences in Methods Used to Assess Science Learning in PreK Classrooms

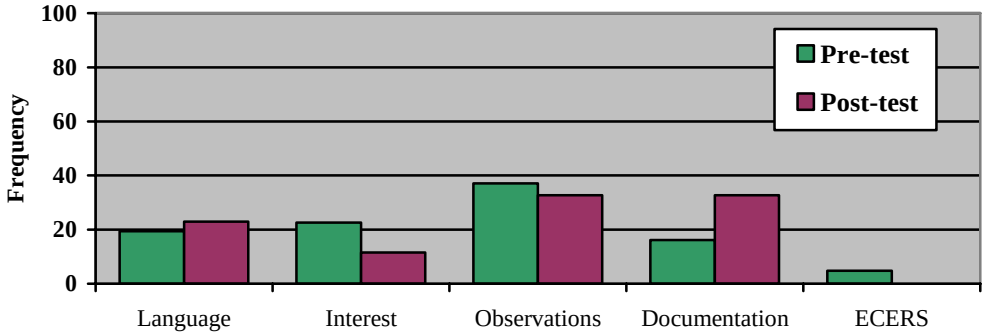


Table 12
Pre/Post Questionnaire Response Differences in Methods Used to Assess Science Learning in PreK Classrooms

Assessment Method Category	Pre-test (N=26)		Post-test (N=21)	
	N References	%	N References	%
Children's language	12	19.4%	14	23.0%
Children's interest	14	22.6%	7	11.5%
Teacher's observations	23	37.1%	20	32.8%
Documentation/Representation	10	16.1%	20	32.8%
ECERS	3	4.8%	0	0.0%
Total	**62**	**--**	**61**	**--**

The primary tools used in this pilot project to assess and support the translation of science content into the learning environment were the STERS and the master teacher logs. In the context of the ECE professional development series pilot effort, STERS data were used to help

preK master teachers and classroom teachers identify specific goals for enhancing the exploration of science concepts with children. Master teachers received a full day of STERS training conducted by EDC staff and then administered the instrument in fall 2005 and again in May 2006. The master teacher logs provided a systematic process to capture the coaching activities used by master teachers to strengthen classroom teachers' work in areas that were identified as "in need of improvement" through the STERS.

Assessing the Translation of Science Content into the Learning Environment Using STERS. The STERS is designed to measure the quality of the science learning environment as documented through classroom observation and pre/post observation teacher interviews.[23] It organizes science teaching into seven components; five of these components are documented through the classroom observation (the physical environment for science learning, science-related hands-on exploration, representation of science experiences and ideas, use of oral and written language in science inquiry, and small and large group science talks) and two components through teacher interviews (planning for in-depth science investigations and assessing children's science learning). Data collected through this instrument are analyzed using a scoring rubric that categorizes the results from each component on a scale of 1 to 4 (the highest possible total score being 28) with the following interpretation:

- 1.00 = Inadequate – There is **minimal or no evidence** of an intentional approach to the organization of space, selection of materials, and displays that is related to science learning.
- 2.00 = Partial – There is **some evidence** of an intentional approach to the organization of space, selection of materials, and displays that is related to science learning, but evidence is uneven.
- 3.00 = Adequate – There is **adequate evidence** of an intentional approach to the organization of space, selection of materials, and displays that is related to science learning.
- 4.00 = Exemplary – There is **strong evidence** of an intentional approach to the organization of space, selection of materials, and displays that is related to science learning

Master teachers conducted seven STERS observations[24] in fall 2005 between mid-September and mid-October. At post-test (in May 2006), six STERS observations were conducted in the same classrooms.[25] Figure 4 and Table 13 present the pre/post mean scores and standard deviations for each component of the science learning environment as measured by the STERS.[26] At the pretest administration of the STERS, the mean total score for NJ MSP pilot project classrooms was 17.64 and at posttest it was 24.00, an increase of 6.36 points. At pretest, average scores in each of the seven components of science teaching ranged between the "partial" and "adequate" range (2.21 to 3.14). The largest mean score was received for observing teachers *facilitate science related hands-on exploration* (3.14). The lowest average scores were received

[23] The classroom observation typically lasts between 45 minutes to 1.5 hours and the pre/post interviews are 15 to 20 minutes each.

[24] Five observations were conducted in the classrooms of teachers who participated in the NJ MSP ECE professional development series. The two remaining observations were conducted in classrooms of teachers who did not attend professional development sessions, but participated indirectly through coaching provided by their master teachers on the STERS' purpose and content; these teachers' classrooms were also observed by the learning community during the professional development session hosted by their district site.

[25] By posttest, one of the participating teachers had resigned, so a post-observation could not be conducted in that classroom.

[26] For detailed STERS pre- and post-administration results, see Appendix M.

for the encouragement of the *representation of science experiences and ideas* and the *use of oral and written language in science inquiry* (2.21 each). At posttest, average scores on each of the seven components of science teaching fell in the "adequate" range (3.17 to 3.83). The largest mean

Figure 4
Mean Pre/Post Scores on the STERS Assessment

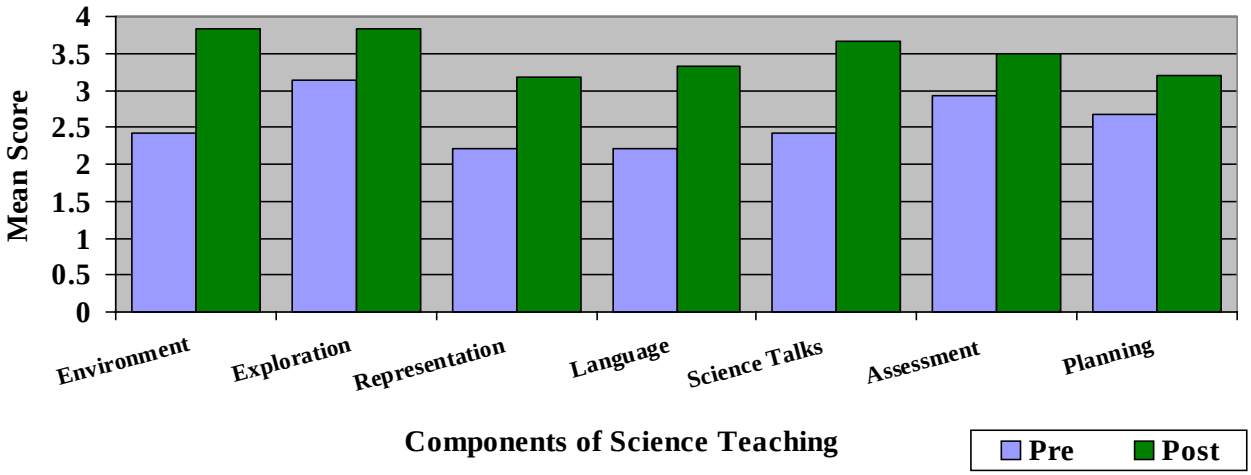


Table 13
Mean Pre/Post Scores[1] on the STERS Assessment

Components of Science Teaching[2]	Pretest[3]		Post-test[4]		Pre/Post Difference
	Mean Score	Std. Dev.	Mean Score	Std. Dev.	
1. Create a physical environment for inquiry and science learning	2.43	.90	3.83	.41	+1.40
2. Facilitate science related hands-on exploration	3.14	.69	3.83	.41	+.69
3. Encourage representation of science experiences and ideas	2.21	1.1	3.17	.75	+.96
4. Use oral and written language in science inquiry	2.21	.91	3.33	1.03	+1.12
5. Facilitate small and large group science talks	2.43	.53	3.67	.52	+1.24
6. Assess children's science learning	2.93	.73	3.50	.55	+.57
7. Plan in-depth science investigations[5]	2.67	.52	3.20	.84	+.53
Total	**17.64**	**4.17**	**24.00**	**3.41**	**+6.36**

[1]Mean scores represent the average STERS rating provided for each component across all STERS administrations that were conducted.
[2]The STERS four-point rating scale is as follows: 1 (Inadequate), 2 (Partial), 3 (Adequate), and 4 (Exemplary). The highest possible total score on the STERS is a 28.
[3]The number of pretest observations conducted was seven.
[4]The number of posttest observations conducted was six.

[5]At both pre- and posttest, one master teacher left the score for component 7 blank.

scores were received for observing teachers *facilitate science related hands-on exploration* and *creating a physical environment for inquiry and science learning* (3.83 each). The lowest average scores were received for the encouragement of the *representation of science experiences and ideas* (3.17) and the planning of *in-depth science investigations* (3.20).

All of the individual component scores increased from pre to post. While at pretest the STERS scores for each component ranged from 2.21 to 3.14, at post-test the range was nearly one point higher (3.20-3.83). The greatest increases in scores were shown in Component 1 (1.4), which addresses the physical environment, Component 5 (1.24), which examines teachers' facilitation of small and large group talks, Component 4 (1.12), which examines the facilitation of science talks, and Component 3 (.96), which examines how teachers encourage the representation of children's science experiences and ideas. As discussed more below, gains in these areas are consistent with the focus of master teacher coaching and teachers' goals for improving science learning during the pilot project.

Documenting Coaching Activities Conducted by Master Teachers. Results from the STERS pretest administration were used by master teachers and classroom teachers to identify aspects of block area activities that "needed improvement" in order to maximize children's science learning through building blocks play. As mentioned earlier in this section, overall results from the pretest STERS administration (derived from master teachers' comments that were used to determine the STERS scores) identified the areas listed below as being most in need of improvement.

- The Physical Environment for Inquiry and Science Learning. Master teachers documented that there needed to be more books and that the quantity and variety of materials in the block area was limited. Goal statements for improvement developed by master teachers and teachers included "Create a 'science rich' environment by displaying and having accessible books that inform and stimulate inquiry." It is interesting to note that as teachers become more informed abut content and how to support children's focused inquiry, they realize the potential for the learning setting that comes from additional resources, and they seek, therefore, to acquire them.

- The Representation of Science Experiences. Master teachers identified needs with regard to the labeling of documentation panels, documenting students' conversations on student work, and focusing the children and encouraging reflection. Goal statements for improvement developed by master teachers and classroom teachers included "Use documentation to show sequence of learning activities [in order] to evidence learning and stimulate thinking," "Use documentation panels to encourage children's reflecting," and "…outline exploration and focused inquiry using class photos."

- The Use of Oral and Written Language in Science Inquiry. This need was documented by observing teacher-to student conversations and the early stages of the documentation of students' work. Two master teachers noted that the children were starting to write and plan. "Chart (Documentation Panel) children's science experiences, use their dictation to

document…," and "Identify[ing] science concepts that could be focused on during conversation with the children."

- The Facilitation of Small and Large Group Science Talks. Master teachers identified needs in this area and goal statements were generated related to teachers having these talks more often, continuing "to encourage student-to-student conversation" and "encourage children to share experiences," and "encourage child-to-child communication in which children compare or discuss their differing ideas."

The master teacher logs were used as a tool to document coaching activities conducted with teachers to improve performance in the goal areas identified through the STERS. Information captured on the log included the names of the master teacher and the classroom teacher being coached, the date of the coaching activity, the STERS component that was focused on during the coaching session, the method of coaching (observation, conferencing, or modeling) and the next steps identified for providing follow-up support. Information documented on the logs was shared during professional development follow-up sessions and according to the NJ MSP EC Specialist, the collective review and sharing of the logs "contributed to [master teachers'] awareness of additional ways to mentor the classroom teacher…" Each of the five master teachers who participated in the ECE professional development series completed logs during the period November 2005 to March 2006. The number of logs completed by master teachers ranged from four to nine, with the average number being six. Four of the master teachers documented their coaching experiences with one teacher, and one master teacher documented work with two teachers; in all but two cases, the documented coaching activities occurred with teachers who attended the professional development sessions. Of the 28 log entries that identified the methods of coaching used, the most frequently cited was "conferencing" with the teacher (43%), followed by "observing" the teacher (36%), and "modeling" for the teacher (21%).

Feedback from the learning community participants seem to indicate that the master teachers logs served the greatest utility as discussion tools for master teacher and classroom teacher conferencing sessions and for group review and sharing sessions among master teachers. One preK teacher commented that her review of the logs "cleared up some concerns." Feedback from master teachers indicates that they valued the opportunities for group review and discussion of the logs because they, "…need[ed] more info in this area, to be sure I was headed in the right direction" and liked "sharing some of the experience that other [master teachers] are having and how it is working for them." One EC supervisor reported that the log review and discussion sessions she participated in seemed to indicate that "[coaching was] much more effective when the master teachers and teachers participated together [in the classroom] rather than the master teachers just modeling in the classroom." Most notably, as the following comments indicate, master teachers perceived that their coaching techniques had been effective in moving teacher practice and the classroom environment toward that of being more conducive to opportunities for science inquiry and learning.

> *[The teacher] has moved open exploration of blocks to include focused explorations about science concepts. The three-year-old children have learned key terms and observe their "structures" for balance, design, patterns, and comparative terms. [The teacher]*

keeps the center fun and lively through direct interactions. Representation and displays of children's learning are now a daily part of science and blocks. [The teacher] has added photos and books to enrich the environment. Science inquiry is evident throughout the classroom.

[We are now using more] Representations - Taking it to the next level: line drawing. The use of varied materials: books, posters, calendars, postcards, etc.

[I enjoyed] Sitting with [the] teacher and going over handouts/[the] book [and] video and seeing the teacher using that info in classroom and with class.

We moved from using no "science terms" in verbal interaction and having no documentation panels or children's representations in the classroom to using correct scientific terms and enriching the block area with authentic documentation of student learning.

Extending the Learning Community

Evidence suggests that the impact of the NJ ECE professional development series was not limited to the teachers, master teachers, and EC supervisors who participated in the pilot project, but transcended in ways that led to changes in teaching and learning at the institutional level. Participants reported that the information and materials obtained through the pilot project have been shared, to varying degrees, with the broader ECE community in their respective districts.

- **Bridgeton** participants reported some difficulty in systematically sharing their learning with other teachers because much of the professional development in the district has been centered on incorporating the use of a new curriculum. Participating master teachers indicated that they had shared some of the NJ MSP workshop information with their teachers through coaching, and participating teachers reported they informally shared the information with colleagues. In addition, the resource binders that each participant compiled during the professional development series have been made available to all staff by being included in schools' professional library. In the 2006-2007 school year, Bridgeton plans to address the STERS goals within teachers' Personal Improvement Plans and may also purchase the *Young Scientist* series.

- In **New Brunswick**, the participating master teachers reported that they turn-keyed training to other preK master teachers in the district. All of New Brunswick's preK master teachers attended the May 2006 NJ MSP ECE conference, and the district plans to replicate the learning communities model of embedded professional development within its local professional plan for preK for the 2006-2007 school year.

- In **Phillipsburg**, the participating master teachers started providing inservice on the building structures approach to science learning to teaching staff at local childcare centers, as well as coaching in these techniques to preK and kindergarten teachers located at the district's early childhood center to enhance horizontal and vertical articulation of science inquiry teaching practices. Phillipsburg also utilized documentation panels

developed through the project to engage parents in the learning process during family night events; parents leave these events with "take-home kits" that include exercises that parents and children can work on together to become more familiar with math/science concepts and vocabulary.

- In **South Bound Brook**, participants there reported that they extensively shared the materials and information obtained through the professional development. These participants also conducted a formal presentation of their learning community experience and its impact for their local Board of Education and the County Superintendent.

This extension of the preK learning community experience has even moved beyond the local level to impact professional development planning at the state level. Based on the collaboration that was developed between the NJ DOE OECE and the NJ MSP through the implementation of the ECE professional development component, the EC Specialist has been hired by the OECE (effective July 2006) to join its team of Program Specialists. This transition will help to solidify the legacy and promote the institutionalization of the NJ MSP ECE professional development component.

VII. Lessons Learned from the NJ MSP Early Childhood Education Professional Development Component

The NJ MSP ECE professional development component, although not officially launched until Year 3 of the partnership initiative, emerged from this comprehensive effort as one of the most viable elements of the MSP grant. In effect, the ECE component experience embodies important lessons about how partnerships, teacher quality, challenging curricula, and evidence-based outcomes are developed within the preK setting. Lessons yielded from the ECE professional development pilot effort underscore the importance of an essential set of resources and design strategies that are needed in order to effect sustainable change in teaching and learning environments.

"Time" is the critical resource that is needed in order for teachers to acquire new content and translate it into instructional strategies. In order to enhance teachers' knowledge base in preK programs, it is not only necessary to address their attitudes and fears about teaching science and mathematics but also to provide appropriate content in time sequences that allow for processing the new knowledge. Using the learning communities approach enabled teachers to identify and examine their limitations and then expand beyond current levels of understanding within a safe environment. The time factor is also critical to translating new knowledge into instructional design and teaching practice. The practices within a teaching style change slowly as new understandings and goals emerge, and continued reflection serves as a monitor to change.

Desired change in instructional practice is most effectively realized when it flows from "very focused" professional development. The purpose of the NJ MSP ECE professional development series was well defined and accompanied by supporting materials for both teachers and students. By focusing professional development on a specific instructional design area (building blocks) and examining the learning environment using research-based tools (like documentation and the STERS), teachers and master teachers could identify tangible, doable

goals without feeling overwhelmed by the challenges involved in developing new strategies and confusion about what was expected.

Teachers' acquisition and dissemination of new content requires ongoing access to experts with the necessary knowledge along with the opportunities to observe, try out, and reflect upon the use of quality materials and instructional strategies that support the translation of content into classroom practices. Workshops directed by an expert set the context for acquiring knowledge without stress. Documentation panels served as one major vehicle for helping teachers talk with each other about strategies that they could associate with the increase in children's understanding of science ideas that apply to building structures. Their use enabled the NJ ECE professional development participants to stay focused on the "big ideas" of science content learning. When the goal is to scale-up teachers' acquisition of new content to their peers, it is important that they have the broad-based understanding of the "big ideas" that underpin their work with students. The documentation panels further contributed to ease of communication with children, parents and other professionals about what was being learned. The professional development power of the documentation panels in the NJ MSP project was evidenced through the presentations that participating district teams conducted at the May ECE conference.

Direct linkage between the curriculum content addressed in off-site professional development sessions and the everyday work of curriculum development leaders fosters the translation of the new concepts and techniques into classroom practice through regularly scheduled classroom visits and on-site conferences. In the NJ MSP experience, the successive introduction of curriculum and change in instructional patterns of interaction flowed most effectively when the master teachers and others serving as "experts" (such as the EC Specialist) joined the learning process in the classroom with children. The on-site collaboration between experts and classroom teachers helped to clarify the fit between children's development, the curriculum goals, and the next steps in feeding the learning process. Teachers bring knowledge of the children to task, while experts bring content understanding.

Getting "all the players on the same playing field" was critical to building the momentum of partnership support for the ECE professional development effort. The fields that needed to be brought into the collaboration ranged across the following: local and state leadership levels, local and state curriculum standards and expectations, parent expectations, participant and non-participant teachers within a participating site, and the alignment of the instructional strategies and content to existing curriculum programs adopted by the school. At the professional development sessions, teachers raised and worked on resolving issues of conflict and confusion relative to curriculum and instructional design. The NJ MSP EC Specialist further addressed the needs to coordinate with the state leadership by joining professional development efforts, and mutually participating in each other's sessions. With the absence of one or more players, the efforts of the NJ MSP EC initiative would have suffered setbacks in momentum.

Leadership for professional development efforts needs to be credible, informed, and able to establish collaborations between and among all of the "players" in order to navigate through the myriad of challenges that often occur over the course of a sustained professional development model. The EC Specialist demonstrated exceptional skill and tenacity in acquiring knowledge about the landscape of preK programming in New Jersey and aligning this context to her own professional knowledge of best practices in early childhood learning. However, various unexpected changes in funding resources, participation commitments, and logistical restructuring of the learning community limited the NJ MSP's ability to broadly impact preK teaching and learning across its partner districts. There is potential for the initiative to have a legacy within New Jersey's ECE landscape—the NJ MSP EC Specialist will join the staff of the NJDOE OECE in summer 2006. It is recommended that this transition serve as an opportunity for NJ MSP partners and the NJDOE to build upon the "pilot effort" of the professional development series and expand this capacity building approach to serve preK programs statewide.

In closing, the sustainability and expansion of this ECE professional development pilot effort, now that the NJ MSP has concluded, depends upon the effectiveness of the linkages between local professionals, district- and classroom-based personnel, and the state support for sustaining efforts toward the goals of the ECE component. The Early Childhood Specialist of the NJ MSP ECE professional development component was uniquely successful in establishing critical linkages. In addition, the final session of the project focused on ways to institutionalize the efforts not only in participating communities but also in communities that choose to follow the model of professional development.

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