REPORT OF FINDINGS:
National Science Foundation
Early Childhood Materials Development
Learning Community

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FINAL REPORT
EARLY CHILDHOOD MATERIALS DEVELOPMENT LEARNING COMMUNITY

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Chapter 1—Introduction

Background. The National Science Foundation (NSF) has invested considerable resources in the development of standards-based mathematics and science curriculum and instructional materials for K-12 schools over the past decade. During this same period, researchers and educators have placed an increasing emphasis on the importance of early childhood education (PreK-2) in establishing a strong foundation for future learning of mathematics and science. In Spring 1997, NSF solicited proposals for the development of standards-based mathematics curriculum and instructional materials for PreK-2 students as an initial effort to address needs in the early childhood arena. In Spring 1998, three four-year early childhood mathematics materials development projects were funded and began implementation.

Subsequently, NSF program officers asked Science and Mathematics Program Improvement (SAMPI) at Western Michigan University (WMU) to develop a proposal to facilitate a learning community among the projects. Officially titled, "Conference to Support Early Childhood Mathematics, Science, and Technology Programs" (ESI-9810667) was to include the three funded projects. Program officers subsequently identified a fourth project, a teacher enhancement program to develop a system for documenting primary grades science learning, to participate in the learning community.

The four projects in the learning community were: *Big Math for Little Kids: A Mathematics Program for Preschool and Kindergarten Children* (Teachers College, Columbia University); *Building Blocks—Foundations for Mathematical Thinking, Pre-K to Grade 2* (State University of New York—Buffalo); *Culturally Meaningful Adventure Stories: A Medium for Teaching Kindergarten Geometry and Spatial Skills* (Boston College); and *Primary Science Documentation: Strategies and Materials* (Educational Testing Service). See Chapter 2 for detailed descriptions.

As a requirement of their funding, these four projects participated in learning community activities, including three two-day conferences focused on issues related to their projects (see appendix for details about conferences), surveys and other self-reporting of information to the SAMPI facilitators, and SAMPI visits to project sites. Project Directors (PIs) and project evaluators were expected to attend conferences. Other personnel could also attend at the discretion of the PI. In addition, NSF program officers attended conferences.

Conference topics included: "Equity Issues in the Development of Instructional Materials," "Assessment of Children in Early Childhood Education Programs," and "Policy Impacts on Early Education Programs."

Purpose for the Early Childhood Learning Community. The overarching goal for this project was to develop and conduct a sequence of conferences to create and sustain a learning community among the four projects. The learning community enabled projects to share methods and expertise proven successful in the development of early childhood materials. It united persons engaged in similar tasks, but with differing strengths, knowledge, and skills. Opportunities for more in-depth discussion and analysis of issues were provided.

Congruent to the proceedings of the learning community, an evaluation component external to the four projects was also implemented. Through site visits, interviews, questionnaires, and document analysis, conceptual connections among the projects around common issues, strategies, problems, or dilemmas of instructional product development were developed. A set of common topics related to early childhood materials development was identified by learning community participants, providing a framework for reviewing and analyzing cross-project issues and problems. The purpose of the evaluation component was not to evaluate individual projects, but to study cross-project issues affecting early childhood materials development in order to develop findings and suggestions for NSF as it supports instructional materials development in the future. This report discusses those findings.

Cross-project topics, issues, and elements related to early childhood materials development identified by learning community participants include: (1) grounding in research and standards, (2) degree to which materials provide a foundation in mathematics in preparation for early elementary grades, (3) attention to equity and diversity, (4) support systems (i.e., professional development, dissemination), (5) parent engagement, (6) teacher involvement, (7) evaluation of materials effectiveness, (8) student assessments, (9) documentation of the development process, (10) obtaining a publisher, (11) staffing the materials development effort, (12) budget considerations, and (13) time frame for development.

Methods. Learning community cross-project collaboration was accomplished through the three conferences, distribution of conference reports and other learning community materials, a listserv, exchange of contact information, SAMPI facilitators sharing information at individual site visits, and individual project interactions. Learning community facilitators also distributed a variety of printed materials, including pertinent articles, bibliographies, reports, and other resources. Conference agendas and other materials are provided in the appendix.

Cross-site evaluation activities included two or more visits to project sites; interviews with PIs and other project staff; interviews with evaluators; observations and interviews at field testing sites; gathering and review of proposals, reports, and other project documents; online surveys of project staff; and review of pertinent literature related to

materials development. Conferences also provided a forum for identification of pertinent assessment concerns, discussion of evaluation issues and activities, analysis of evaluative data, and review of findings.

Organization of This Report. Learning community participants identified a set of issues pertinent to early childhood materials development. They are listed above in the purpose section. The report is divided into chapters each with a set of questions addressing pertinent chapter issues. A final chapter offers a set of conclusions and recommendations. There is also a summary of those conclusions and recommendations at the beginning of the report. The appendix includes additional evaluative information, conference agendas and other details, a bibliography, and background on consultants.

A Note About the Timing of This Report. The learning community was actually organized after the four materials development projects were underway, so early activities had to be reconstructed by the learning community facilitators. At the time of this report, all of the projects are in final phases of materials development, but none are complete. The Learning Community timeline was initially three years and was extended to a fourth. Even with this adjustment, the learning community timeline does not match project timelines, since most of the projects received extensions. Readers should note that this report does not include discussion of final products and closure of the projects.

Chapter 2—Description of the Projects and the Types of Products

Big Math for Little Kids: A Mathematics Program for Preschool and Kindergarten Children

At the core of this project is a two-year sequence of explorations and learning activities aimed at extending and elaborating on preschoolers' informal mathematical interests and abilities, and developing their understanding of core mathematical concepts in an enjoyable and exciting way. Although the materials were designed for use by all children, they are intended to be effective with low income, minority children in nursery school, day care, Head Start, and Kindergarten settings. Teacher, care giver, and parent instructional guides (including video demonstrations) were developed.

The program has three primary foci. First, it is centered around eight big mathematical ideas which children need to explore: (1) what numbers mean, (2) how numbers work, (3) putting together and taking apart, (4) parts of a whole, (5) different ways to say the same thing (equivalence), (6) patterns and combinations, (7) measurement, and (8) the nature of shapes and space. Second, the program pays considerable attention to developing children's understanding of mathematical language. Third, the program is designed to enable all students to acquire the core mathematical knowledge they need for early school success in mathematics. The goal of the project is to provide preschool teachers and caregivers with the tools they need to create a systematic, sustained and sequenced mathematical learning environment.

Building Blocks—Foundations for Mathematical Thinking, Pre-Kindergarten to Grade 2: Research-based Materials Development

The main goal of this project was to develop exemplary mathematics curriculum materials for pre-kindergarten to grade 2 children that integrate three media: computers, manipulatives (and everyday objects), and print. The development of computer software is a primary component of the project.

The material emphasizes the development of basic *mathematical building blocks (*ways of knowing the world mathematically) organized into two areas: (a) spatial and geometric competencies and concepts and (b) numeric and quantitative concepts, based on the considerable research in that domain. Three mathematical sub-themes: (a) patterns and functions, (b) data, and (c) discrete mathematics (classifying, sorting, sequencing); will be woven through both main areas. Most important will be the synthesis of these domains, each to the benefit of the other.

Culturally Meaningful Adventure Stories: A Medium for Teaching Kindergarten Geometry and Spatial Skills

This project's goal was to develop, evaluate, and disseminate innovative mathematics instructional materials for teaching spatial skills, spatial patterning, and geometry skills at the pre-k and kindergarten level. The mathematics concepts are taught to the

kindergartners through "Mathematics Problem-Solving Adventure Stories." Teachers present oral stories to the children that feature multicultural characters from folktales who pose geometry and spatial problems. The kindergartners solve the problems using manipulatives and other hands-on materials. Through math story sagas, the math-language arts curriculum makes use of the oral story-telling tradition to provide a context, continuity, and motivation for the learning of math concepts. Based on National Council of Teachers of Mathematics (NCTM) and National Association for the Education of Young Children (NAEYC) recommendations, these instructional materials make a contribution to the field of early education by: (1) incorporating gender and racial/ethnic diversity in the mathematics curriculum in a substantive way, (2) integrating mathematics learning throughout the kindergarten curriculum using "developmentally appropriate practices," and (3) shifting the focus of early math education from a mainly arithmetic-based curriculum to one that incorporates geometry and spatial skills.

The stories are presented in eight modules, which can be used as "stand alone" units throughout the school year, and cover approximately one quarter of the recommended kindergarten mathematics curriculum (NCTM, 1989). The present materials are designed to provide new ways to integrate mathematics ideas into literature and language arts, and are flexible in that they can be presented within many parts of the daily kindergarten curriculum. The goal of the spatially-related activities presented in this kindergarten curriculum is to develop a type of mathematical thinking in children at this age that encourages the later use of image generation and manipulation, and to use diagrams and drawings when solving complex math problems. Socio-emotional aspects are part of the design as story telling can change the atmosphere. It removes the book from between the teacher and the student. It allows for more interaction between students and teachers and allows for a different relationship with children.

Primary Science Documentation: Strategies and Materials—Educational Testing Service

The major goal of this project was to develop effective classroom-based strategies and materials for documenting young children's science understandings. As a model for assessment, the process of documentation is designed to enhance teachers' capacities for observing, recording, and understanding children's learning. Building extensively on findings and prototypes from prior NSF-supported work, this project developed multimedia documentation materials (text, video, CD-ROM formats) which disseminated project outcomes to teachers, science support staff, administrators, and teacher educators. The materials illustrate the rationale of documentation, its uses, and strategies used to record and analyze children's science language and work samples.

The project explored ways in which documentation broadens educators' awareness of the range of assessment options, enhances educators' understanding of young children's learning, and enhances teachers' abilities to reflect on their instructional practice. As part of the project, professional development study groups evaluated documentation strategies and examined uses of documentation for accountability purposes. This model also presumes that documentation can serve multiple purposes in the classroom, such as

finding out what students bring to the study of some phenomena by way of past experiences, monitoring ongoing work of students, and determining what students have actually gained from their studies.

Summary of Projects

Age/Grade Level Applicability. All four projects developed materials applicable to Pre-K children. Two of the projects addressed Pre-K and Kindergarten, one Pre-K to 2nd grade and one Pre-K to 4th grade.

Subject Matter Focus. Three of the projects focused on mathematics instructional materials and one project on science assessment materials.

Teaching /Learning Model (How Students Learn). *Project* 2 is based on a model that promotes children's inquiry and problem-solving guided by cues in the children's behaviors and language. The process of assessment, promotes the inquiry. The other three projects use inquiry-based problem solving as the foundation for instruction. Activities are grounded in children's everyday lives. Story-telling, dramatics, and music are other vehicles used to engage children in mathematics through contexts that are familiar and enjoyable.

Impact on Teachers Practice. Although each of the projects intends to impact teachers' practice in a different way, all projects have aligned these intentions with national standards for teaching and learning.

- Project 1 expands teachers' capacities to integrate technology with the mathematics curriculum.
- Project 2 focuses on building teachers' abilities to observe, record, and understand children's learning.
- Project 3 enhances teachers' capacities to use oral story-telling traditions to expand children's geometry, spatial, and mathematics understanding.
- Project 4 develops teachers' abilities to integrate mathematical explorations into many activities such as free play, circle time, group projects, music, housekeeping routines, and one-on-one conversations.

Materials Development Processes All of the projects initiated materials development based on previous research conducted by the Principal Investigators as well as other validated educational research. In addition, projects conducted exploratory research observing the mathematical behaviors of young children during free play and during instructional programs, interviewing teachers, and questioning students to develop effective questioning for assessing science learning. All of the projects used field-testing as a formative process. In addition, projects used videotaping of field-testing and study groups with teachers and graduate students to aid in the revision process of draft materials.

Educational Product Educational products among the four projects vary considerably, although each is grounded in inquiry-based learning.

- *Project 1* is developing a mathematics curriculum integrating three media: computers, manipulatives, and print. Computer software is an integral component of the curriculum. In addition, there is a manual for teachers, activity sheets for children, videos to introduce concepts to children and adults, and physical manipulatives.
- *Project 2* is different from the other three projects in that it focuses on methods of assessment rather than curriculum. The central product will be a series of videos illustrating documentation of children's knowledge. There will be a notebook-guidebook linked to the video. In addition, a CD-ROM and an on-line website will support teachers use of the developed assessment method.
- The core product of *Project 3* is a set of six modules of problem-solving adventure stories, that also include manipulatives (such as multicultural puppets), and teacher guide-books. In addition to instructional guidance, guidebooks include curriculum webs that suggest related activities across the early childhood curriculum. Supplementary resources are also listed such as books, web sites, and related CD-ROMs.
- *Project 4* has developed teacher guidebooks, manipulatives, original storybooks, materials for parents, and video-based workshops for teachers and parents. During the national field test, vignettes of ways in which the program can be used in different locales with varying demographics will be developed and included.

Chapter 3—Standards and Research: How have materials been grounded in research and appropriate standards?

What were effective methods of aligning materials with national and state standards?

The mathematics projects have a common focus on the four NCTM curriculum standards related to mathematical thinking. These four standards focus on mathematics as:

- *Problem-solving.* Fostering curiosity and inquiry to develop strategies for answering questions themselves.
- *Reasoning.* Sense-making, testing models, using patterns and relationships to find meanings.
- *Communication.* Reflecting on their ideas and clarifying their thinking about mathematics; relating their everyday language to mathematical ideas; realizing that presenting, discussing, listening, reading, and writing are all important components of learning mathematics.
- *Connection.* Building the connections between the intuitive, informal mathematics from students' experiences to the mathematics they are learning at school. Recognizing and applying mathematics in contexts outside of school.

The science assessment project builds on the National Research Council teaching standard: "Teachers are continuous learners, inquiring into the understanding of science, their students, and their teaching practice." (NCES, 1994). The goal is for assessment to be continuous, to look at multiple sources of evidence, and to focus on understanding children's attitudes, skills, knowledge, and learning processes.

In 2000, Principal Investigators of Project 1 were funded by the National Science Foundation and the Exxon Mobil Foundation to hold a national conference to provide a full, detailed vision of the NCTM standards for early childhood (http://www.gse.buffalo.edu/org/conference/maincon.htm). This conference brought together a comprehensive range of experts in diverse fields relevant to the creation of specific educational standards. Participants included representatives from almost every state developing standards for young children's mathematics as well as federal agencies; mathematicians; mathematics educators; researchers from mathematics and early childhood education; psychology; teachers; policy makers; and representatives from national organizations such as the National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC). The participants of the ECLC study project also took an active part in this important conference (Clements, 2001). A presentation on the outcomes of this conference was later made to the ECLC in December 2000 and summarized in an article in a recent issue of Teaching Children Mathematics (Clements, Sarama, & DiBiase, 2002). Detailed outcomes will be accessible in a book to be released by Lawrence Erlbaum Publishers in the fall of 2003.

Project 2 used a consultant from the Merck Institute for Science Education to help evaluate the links between the project's materials and the national science standards. A

consultant from the National Assessment of Educational Progress (NAEP) office provided support in evaluating the materials in light of the national assessment frameworks. Project 3 developed a matrix that aligned components of the instructional module to the NCTM Standards.

A study examining Pre-K standards across the 50 states was conducted by Project 4. It was found that few states had identified mathematics standards for Pre-K classrooms and those that existed were often vague and ambiguous.

What are the challenges in developing materials that are developmentally appropriate?

The term "developmentally appropriate" raises many questions for educators. This group of Principal Investigators stress the importance of thinking about it at an individual child level, considering that young children's mental and physical abilities change rapidly and vary greatly among children. In addition, perceptions of what is meant by "developmentally appropriate" differ.

> *"It also depends on what you mean by developmentally appropriate. For a long time the NAEYC defined it as achievable but challenging. The old definition relates to the cognitive development of the child but the new definition challenges the child to new levels of development."* (Project 1)

This definition of "challenging the child to new levels of development" seems to be shared by all four projects.

> "*The challenge is to meet everyone's needs."* (Project 3)
>
> *"The object of the program will be to build a bridge from the rich informal mathematical knowledge young children acquire on their own to the symbolic knowledge required in school. This will be done by gradually moving from primarily concrete activities to more abstract ones over the course of the program while maintaining a consistent methodology of embedding the activities in familiar or interesting contexts and infusing them throughout the school day in a playful manner."* (Project 4)
>
> *"A variety of types of assessment documentation is important in order to accommodate a wide range of developmental levels in young children."* (Project 2)

All of the projects are in alignment with a core NAEYC principle of developmentally appropriate practice: "Children are active learners, drawing on direct physical and social experience as well as culturally transmitted knowledge to construct their own understandings of the world around them."

Another issue faced by these four projects is the innovative nature of the materials. Because these projects are charting new territory for pre-school education, documentation

of the appropriateness of these types of materials is scant. This is particularly true of Project 1 because of the integration of computer software into the curriculum.

> *"This is a unique problem for this project because of the interface of the computer. How long should young children be engaged in computer activities? There is not definitive research. The good part of this is that the software can be individualized. Kids can differentiate according to what they can do."* (Project 1)

What standards have been referred to in the development process?

The three mathematics projects place a major focus on the NCTM Standards. Problem-solving and reasoning skills are central to the curricula. The projects emphasize the development of spatial representational skills through constructing, drawing, diagramming, graphing, and mapping. Mathematics language skills are developed through story telling in Projects 3 and 4. All of the projects help children to see and understand the mathematics in everyday activities. Project 1 does this through computer software with classroom scenes and settings such as a playhouse and a block center. Project 3 uses adventure stories, while Project 4 uses stories, music, and common household activities.

The science assessment project, Project 2, is aligned with the National Science Education Standards. The guiding principle is that assessment methods focus on what students can do, rather than focusing on instructional practice and are referenced to the science standards. The American Association for the Advancement in Science (AAAS) Benchmarks for Science Literacy (1993) are also a foundation for the assessment system. Project 2's assessment system is grounded in the documentation of children's behaviors and language as a measure of science learning which is a core concept of the AAAS Benchmarks.

At one ECLC conference there was extended conversation around issues of early childhood standards. A concern was raised as to whether these standards would lead to behavioral objectives and high-stakes testing in early childhood programs.

> "*There is a substantial and critical difference between standards of excellence and standards as a requirement for mastery. When we think of the second definition, we are often talking about 'tests as standards.' Then the test becomes the curriculum and that is NOT the path we choose to follow."*
>
> *"Are people going to take away specifics or will they look at this as a whole? Will the standards become behavioral objectives? There must be space for 'messin' around (i.e., teacher setting up the situation and encouraging children to inquire). I wouldn't want standards to be more limiting than enabling."*

What educational theories have provided the grounding for the materials?

Although the projects are common in their alignment to national standards, the theories which provided the impetus and grounding for these projects differ. These differences are not contradictory but reflect different foci. Two of the projects talk about broad principles that frame how their materials were developed.

> *"You can stake out landmarks of kids' pathways of learning in mathematics. That can guide curriculum development. But multiple pathways are important; they should not be programmed. Multiple experiences with a concept in individual and social settings are an important building block. Children need multiple ways of representing mathematical and scientific ideas.* (Project 1*)*

> *"The first purpose of assessment in early childhood should be to enhance teachers' capacities to observe, document, and understand learning."* (Project 2)

> *"Participants should perceive and use 'mistakes' of children and adults as a challenge and opportunity for new growth."* (Project 1)

There are both similarities and differences in theories that provide the foundations for different components of their curricula. Project 3 uses theories of Piaget and van Hiele.

> *"Piaget considered representational abilities to be constructed from the active manipulation of the environment"*

> *"Failure to reach higher levels of geometric thinking may be due in part to a failure to offer geometric problems in the early years."* (van Hiele, 1987)

Van Hiele's theory of the importance of progressive steps in the development of geometric thinking is also central to Project 1.

> "*Based on the theory that a critical barrier to students' successful learning of geometry is the failure of standard geometry curricula to systematically facilitate students' progressions from basic intuitions to concepts of higher levels of geometric thought."* (Project 1)

It is also van Hiele's theories that provide the reasoning for Project 3 developing a curriculum that draws girls and minority cultures into mathematics and spatial reasoning at an early age. The integration of literature into mathematics provides the "hook" for many children to become engaged with mathematics. This is supported by Pellowski's work in using literature and storytelling to teach mathematics.

> *"Integration of mathematics and literature helps mathematics become more accessible for those children from oral-based cultural/literary traditions."* (Pellowski, 1990)

Project 4 engages children by presenting mathematics in contexts that are natural and familiar to children. It is built on the premise that pre-school mathematics should prepare children for the formal symbolism of mathematics by establishing clear links between informal mathematics and the formalisms of school mathematics (Ginsburg, 1996). This can be linked to the core tenets of Vygotsky's theories, which provide the foundation for presenting learning situations in contexts meaningful to children. Vygotsky's theories also describe the importance of tools (which include use of language and problem-solving skills) to the pattern and rate of cognitive development in children.

> *"Preschool mathematics should help the child advance beyond his or her initial informal ideas. The teacher should help the child to 're-invent' formal mathematics—to construct ideas and procedures that would not have arisen spontaneously in the child's mind in the absence of adult help." (Vygotsky, 1978)*

> *"Preschool mathematics should encourage the rudiments of a reflective, meta-cognitive approach to early mathematics, self-awareness; verbalization-communication; checking-monitoring one's work; generalization; seeing relations and appreciating abstractions."* (Vygotsky, 1986, 1994)

Project 4 is built on the idea that young children are ready and eager to learn *big* mathematical ideas, supported by the theory that preschool mathematics should engage the child in thinking like a mathematician—making interesting conjectures, engaging in problem-solving, looking for patterns (Resnick et. al. 1991). Project 1 also uses the theory of progressing from the informal to the formal and progressively building problem-solving abilities.

> *"Materials should be progressively layered to help children and adults find the mathematics in and develop mathematics from everyday activities."* (Project 1)

This is in contrast to children using prescribed problem-solving methods specified by a teacher or adult.

> *"Children should develop problem-solving abilities based on rich conceptual knowledge structures, rather than learn to apply teacher-prescribed methods to complete tasks.* (Clements & Battista, 1990).

Project 1 identifies theories that provide the rationale for integrating computers into the curricula.

> *"Children learn from interaction with socio-cultural artifacts such as computer software* (Steffe, 1996)."

> *"Computers encourage students to make their knowledge explicit, which helps them build integrated-concrete knowledge* (Clements & McMillan, 1996)."

What specific kinds of research or best practices have been used?

The four projects drew heavily from research conducted previously by the Principal Investigators themselves. Research findings emerged from earlier instructional materials development projects, as well as research projects funded by the Spencer Foundation, NSF, ETS, and their respective Universities.

Project 1: This project has built on the foundation of a previous instructional materials development project and a research project in which the Principal Investigators were part of the development/research teams. The research project, An Investigation of the Development of Elementary Children's Geometric Thinking in Computer and Non-Computer Environments, was funded by the National Science Foundation (MDR-8954664). The goals of this research were to: (1) describe the sequence of cognitive constructions that children make in learning geometry and to elaborate on the levels of geometric thinking and the mechanisms by which students progress through the levels and (2) describe the essential features of computer and non-computer environments. (Project 1 Proposal). The instructional materials development project, "Investigations in Number, Data, and Space: An Elementary Curriculum," goals were: (1) offer students meaningful mathematical problems, (2) emphasize depth in mathematical thinking rather than superficial exposure to a series of fragmented topics, (3) communicate mathematics content and pedagogy to teachers, and (4) substantially expand the pool of mathematically literate students. The Principal Investigator of Project 1 co-developed the geometry/spatial sense units. He also (with the co-PI of Project 1) designed, programmed, and tested a geometry-specific version of the computer programming language Logo, called Geo-Logo, in the context of this project.

Project 2: One of the Principal Investigators of Project 2 conducted research as a cognitive psychologist studying the evidence of early learning in literacy and science. This NSF supported research (TPE-9155341) set out to identify the different settings in which to record children's talk with the goal of discovering boundaries of children's science knowledge. A framework for primary science documentation was developed along with procedural recommendations. Although this provides the core research for this project it is also aligned with work by Bredekamp and Rosegrant that culminated in the Guiding Principles of Preschool Assessment (1995). These principles emphasize (1) multiple forms and sources of assessment, (2) evidence collected over time, (3) evidence highlighting what the individual knows, and (4) evidence of the collective knowledge of groups of learners.

Project 3: A core theory of Project 3 rests on research conducted by the Principal Investigator and is supported by others. This research shows that there are positive correlations between spatial ability and mathematics achievement at all grade levels (Clements & Battista, 1992) The Principal Investigator expanded this research to learn that it is spatial skills that give males the edge in mathematics (Casey, Nuttal, and Pezaris, 1997). Earlier research showed that through block constructions, children

informally explore scientific concepts such as balance, stability, gravity, and weight distribution. These concepts are related to mechanical reasoning, a type of skill that has been shown to be a strong predictor of math achievement. (Project 3 Proposal)

Project 4: The research providing the foundation for this project was Project Competence, supported by the Spencer Foundation. The Principal Investigator of Project 4 has led an extensive investigation of preschool children's mathematics competence in the context of a low-income daycare center serving mostly African-American and Latino families. Findings show that (1) Children are intellectually alert and active, but seldom challenged with stimulating educational activities, (2) Although well intentioned, the teachers and daycare providers are poorly trained (and poorly paid) and for the most part afraid of mathematics, and (3) The parents are deeply interested in and concerned about their children's education; but because they themselves have often experienced poor education, they are not clear on what comprises adequate preparation or how they can help their children at home. Psychological observations of children included naturalistic observation and the clinical interview method (Project 4 Proposal).

In addition to the Spencer Foundation research, Project 4 builds on extensive research on clinical interviewing and assessment of children by the Principal Investigator. It also uses key features of existing exemplary preschool and kindergarten programs that have research foundations. These are the UCSMP kindergarten program, Miss Mason's Math, and Japanese AMI materials. Key principals for each of these programs were on the advisory board or design team of Project 4. (Project 4 Proposal)

Summary. All projects place alignment with national mathematics and/or science standards as a high priority. In addition to aligning their own projects, all have contributed their expertise and experiences to the development of national standards designed specifically for pre-school education. Projects are grounded in well-recognized educational theories and in extensive research conducted previously by Principal Investigators.

Chapter 4—Articulation: How have materials been developed to give students a foundation in mathematics in preparation for early elementary grades?

How do the early childhood materials align with the rest of the K-12 curriculum?

All ECLC mathematics materials development projects have developed and evaluated classroom materials designed to build a foundation in each of the mathematics content strands recommended for Grades Pre-K – 2 by the *Principles and Standards for School Mathematics* (NCTM 2000). Schools are using these standards across the nation to guide their development of mathematics curricula and subsequent selection of classroom materials. The acceptance of the *Standards* by the education community facilitates alignment across levels and flexibility in the choice of mathematics materials.

NCTM *Standards* further recommend that mathematics evolve through children's play and through exploring their world so that they might construct viable connections and develop positive dispositions towards the subject. The approach taken in Project 1 reflects this position and is consistent with that taken by the other projects.

> *"The basic approach is finding the mathematics in, and developing mathematics from, children's activity. The materials will help children extend and mathematize their everyday activities, from building blocks to art to songs to puzzles. Thus, activities will be designed based on children's experiences and interests, with an emphasis on supporting the development of mathematical activity. Mathematization emphasizes representing activity – creating models of activity with mathematical objects and actions. The materials will embody these actions-on-objects in a way that mirrors the theory– and research–based mathematical activity, or mental actions, of students. These are children's cognitive building blocks."* (Project 1)

Integrating mathematical concepts into the student's world requires that mathematics activities not be isolated from the total learning experience. Such integration becomes even more critical at the preschool and kindergarten levels where the socio-emotional and cognitive development needs must be addressed.

> *"The mathematics concepts are taught to the children through the medium of oral storytelling. The oral stories in this math curriculum provide a major link, not only between mathematics and emergent literacy/language arts, but to the rest of the kindergarten curriculum as well. To a large extent, in the majority of other early childhood mathematics programs, the mathematics content is de-contextualized from the rest of the kindergarten curriculum. The story sagas provide an opportunity for thematic development that can be extended to all parts of the curriculum*." (Project 3)

> *"Materials will be developed which will enable care-givers, teachers, and children to incorporate mathematical activities into circle time, free play, guided explorations, small group projects, one-on-one conversations, and music and dance, as well as daily housekeeping activities like attendance keeping and lining up. There will also be strong connections to literature, science, and technology."* (Project 4)

The major goal of the science project participating in the ECLC is to develop strategies and materials for documenting young children's science understandings. The contribution that these materials can make to the accomplishment of goals across the school science curriculum is reflected in the following.

> *"The teacher's powers of observation and knowledge of children's learning are central to successful teaching of primary science. The hands-on science envisioned in current science education frameworks, presumes interactive instruction where teachers are responsive to young children's interests, background knowledge, and emerging skills (AAAS, 1993; NRC, 1996). Science instruction, which promotes children's inquiry and problem solving, must be guided by cues in the children's behaviors and language as well as by curriculum expectations. Whether the program is defined by science themes, units, or kits, the role of the teacher as observer and shaper of the classroom program is critical."* (Project 2)

What are the differences between developing materials for Pre-K and Primary Grades?

Developmental stages are not distinct among four and five year olds. The materials developer must consider this range of developmental stages in the design of activities in the attempt to serve all children. The range of preparedness together with the lack of reading skills and immature communication abilities create added difficulty in assessment of student learning. Additionally, at the pre-school level, one becomes aware of the fact that transitional knowledge is not tested.

A lack of widely accepted formalized learning and/or teaching standards for pre-K, precipitates mixed expectations for the pre-K content and concomitant heightened variability in the kindergarten classroom. This further compounds the resistance of publishers towards investing major resources in a product whose philosophical underpinnings may fall on disfavor.

Summary. By focusing on alignment with national standards, the projects are laying a solid groundwork of preparation for early elementary grades across the country.

Chapter 5—Equity: How have materials been developed to address issues of equity and diversity?

An important and early focus for the ECLC was the issue of equity, including use of materials in diverse cultural settings, infusion of multiculturalism, urban v. rural contexts, child development issues, learning styles/learning differences, family involvement, and professional development needs.

What are the challenges in adapting the materials for learning differences?

A key element of the learning community discussion centered on the complexities of allowing for individualization in using instructional or assessment materials to make them equitable for a wide range of learning differences. Assessment issues, in particular, received attention.

> *" Teachers need to respond in a manner appropriate for individual students as they collect records of participation and become aware of the child's needs. Thus the assessment and documentation of performance becomes an integral component of daily activities."*
>
> *" Focusing on what children know instead of what they don't know is important."*

Participants also talked about very specific ways of adapting materials, such as wording questions in ways that children can respond at a variety of levels and still be reinforced for their contributions. Another suggestion was to follow whole group activities with related learning centers to provide opportunities for child-initiated experiences appropriate for individual learners.

Strategies that individual projects used were:

- *"Meeting with consultants to develop adaptations for visually impaired or those students needing second language support. The materials are progressively layered—users will be able to 'dig deeper' into them to reach increasingly rich, pedagogical and mathematical levels."*
- *"Lessons have been piloted in cognitively diverse (full inclusion) classrooms."*
- *"Providing developmental, hands-on tasks that support a range of learning abilities/experiences of children from diverse ability backgrounds, including those with language and cognitive delays."*
- *"Providing supporting activities in addition to the core activities so that teachers can provide additional experiences for children who need more intensive work.*"
- *"Providing home activities that are designed to extend, deepen, and individualize the mathematics learning."*

What are the challenges in developing the materials for use with linguistically diverse children?

The linguistic diversity of urban classrooms has been increasing rapidly. This creates complexities in the classrooms at all grade levels. These problems are often heightened in pre-school programs when there are several children from non-English speaking homes, since these children may not have had as many opportunities for socialization in English language learning environments. This is considered a "huge issue" by the four projects. However the projects try to use multiple methods to reach those children who do not have strong language skills.

> *"Challenges are being met by providing outlines for each of the stories that simplify the language and the story line to include only core elements. Teachers who are presenting the stories can modify the stories based upon their understanding of their children's linguistic ability. The use of puppets and action-based activities by the children help engage those who do not have a full grasp of the story."* (Project 3)

> *"Although our approach is an outgrowth of the recent popular movement to integrate mathematics and literature, it is unique because mathematics learning becomes accessible for those children from oral-based cultural/literary traditions."* (Project 3)

What strategies were used to incorporate values of equity and diversity among students into the materials?

All projects agreed there is a need to consider equity issues in the initial stages of materials development. It cannot be an add-on. Using multiple forms of representation and collecting multiple forms of evidence of student learning over time were considered important. Use of story telling, music, sound, art, and dance is common among these projects. Projects also used consultants to examine lessons from different perspectives (children and parents) and to look for cultural relevance. Specific strategies used by the four projects follow.

> *"Our materials support multiple approaches to representing situations and solving problems. There is a wide range of multi-culturally sensitive pictures and icons. Materials do not rely on technology alone, but integrate three types of media: computers, manipulatives (including everyday objects), and print. Field testing is planned for taking place in urban, suburban, and rural environments in a variety of situations: home, daycare, and school settings and from a variety of backgrounds, interests, and ability levels."* (Project 1)

"Through math story sagas, these mathematics-language arts materials make use of the oral storytelling tradition to provide context, continuity, and motivation for the learning of early mathematical concepts. Using the oral storytelling approach, we have made a serious effort to design lessons that address gender, racial/ethnic, and cognitive equity issues as integral program components…..Gender equity is addressed by making connections between home and school cultures. Systematic spatial experiences are provided for females to help close the gender gap in this area." (Project 3)

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"Children become active participants as the stories unfold. This is particularly critical for the younger, less developmentally mature children, who tend to become distracted or disengaged from the learning process." (Project 3)

"Development and field-testing took place predominantly in low-income areas with high percentages of minority students. Field-tests were conducted in daycare, private, and public Pre-K and K programs…. It is hoped that field-testing in year four will extend to rural and suburban areas as well." (Project 4)

"This project was grounded in notions of using multiple forms of evidence and using assessments that allow kids to show what they know rather than focusing on what they don't know." (Project 2)

Equity challenges:

Several reasons for inequities across early childhood classrooms were identified: 1) student-teacher ratios, 2) location of the schools or learning centers, 3) lack of financial resources and 4) access to materials. Many states have not instituted educational standards for pre-schools nor do they provide significant support for them. Efforts at professional development are complicated because of a lack of certification requirements for pre-school staff: There are two major reasons for excessive turn-over of Pre-K staff: 1) the low level of pay and 2) staff continuing their education and obtaining better paying positions. This becomes an equity issue because it has ramifications for the quality of pre-school teachers.

Project Directors were also concerned about the complexities of showing whether the curricula they developed had long-term impact on at-risk children.

"It is difficult to conduct a longitudinal study of at-risk children since they move frequently and are difficult to track."

Summary. Projects attempt to meet equity challenges by providing materials that can be accessed in many ways. Accommodating for differences in cognitive or socio-cultural experiences was key. The projects identify differences in pre-school teacher quality and pre-school environments to be significant challenges.

Chapter 6—Implementation and Dissemination

The ultimate success of these instructional and assessment materials rests largely on implementation fidelity and whether there is wide dissemination to a diverse population across the country.

What strategies have been used to determine the professional development needs of teachers to use these materials effectively?

Each of the projects instituted study groups for their pilot teachers to determine the nature of the professional development necessary to establish fidelity with the materials. Video-tapes of classroom episodes, study group discussions, and autobiographies of mathematics experiences were used in the analysis of professional development needs. The range of needs revealed by the study groups in Project 2 included:

- *"How do you use documentation? How do you know what the change is due to so you can initiate new learning experiences?"*
- *"Use of particular words does not necessarily mean knowledge. Examples from children's conversation: 'Music is alive. Batteries die'."*
- *"How do you deal with "stopping action" in order to document?"*
- *"How do you choose elements to come back to and expand upon?"*
- *"Providing the right questions and the right probes is critical."*
- *"Social construction of knowledge is a huge issue."*

The Co-PI of Project 1 conducted a needs assessment of early childhood teachers and caretakers as the basis of developing a professional development plan in mathematics for this population. This work was done through an NSF funded grant (ESI-9814218): Planning for Professional Development in Pre-School Mathematics: Meeting the Challenge of Standards 2000.

What are the challenges in developing a plan for the professional development of teachers? How can implementation fidelity be sustained?

A major challenge in developing a plan for professional development centers on conditions necessary for early childhood educators/caregivers to take part in professional development. There are problems unique to rural settings as well as issues around language, time, and financial resources. It was suggested that federal pass-through funds might be used to support training.

There was also the implementation issue around teachers' willingness to participate and use the materials. Implementation fidelity may depend on teachers' perspectives, their own theories about mathematics and science, and their own mathematics and science knowledge.

The issue of practicality of the professional development materials is of concern to the projects. "If we create materials that require so much teacher preparation that no school

can do it, are we doing a disservice?" There is awareness that ease of implementation will play a large part in the successful use of the materials.

Fidelity was maintained during the pilot/field test stages by effective use of videotapes. Once the materials are published, the professional development component of the materials must serve to maintain this fidelity.

> *The project is relying on the teacher guides that were developed with the materials to sustain implementation fidelity. Needs vary widely. To assist implementation, the plan is to develop:*
> - *Video training tapes to demonstrate how to successfully implement the stories and activities.*
> - *Wordless illustrated picture books or big books that tell the stories in pictures so that teachers can "picture walk" through the story, as they transition from reading to story telling.*
> - *Audiotaped stories which can be used to practice telling the story. Teachers may opt for having the professional storyteller on the tape present the stories to the children, while the teachers use the puppets and pose the mathematical questions to the children in the class.* (Project 3)

Three of the projects are developing extensive professional development materials to maintain implementation fidelity.

> *"The detailed guides will enable teachers and care givers to guide their students/children through a sequenced series of mathematical activities. Our initial work in day care sites indicates that detailed and comprehensive guidance is necessary because most care givers and many preschool teachers have limited prior experience with mathematics, are often afraid of it, and in general are poorly trained in early childhood education."* (Project 4)

> *"We will produce a series of video vignettes which will show teachers and care givers how mathematical experiences and instruction can be built into the daily activities of preschool, day care, Head Start, etc. We believe these video vignettes will be absolutely essential to the success of the program because preschool teachers and caregivers generally lack good models of effective and appropriate mathematics education. Episodes will illustrate implementation of our new materials, the use of everyday classroom events to teach mathematics, and the integration of mathematics with other day care activities, including art, music, and literature. The vignettes will be used to present teachers not only with illustrations of successful practice, but also with problematic events which raise important issues of mathematics education and pedagogy."* (Project 1)

> "*This project will develop multimedia documentation materials (text, video, CD ROM formats) which will disseminate project outcomes to teachers, science support staff, administrators, and teacher educators. The materials will illustrate*

the rationale of documentation, its uses, and strategies used to record and analyze children's science language and work samples." (Project 2 Proposal)

"Video materials will be developed to help both parents and teachers to observe and interview preschool children. Basically these components involve video segments illustrating children's 'play' or clinical interviews with pre-school children, and engaging parents and teachers in the exercise of interpreting the observed behaviors. Interviews with children can help both parents and teachers to understand that their children are capable of and interested in learning important big ideas in mathematics." (Project 4)

What strategies are going to be used for dissemination?

All of the projects cite presentations at national and state conferences to be a central strategy for dissemination. Five of the Principal Investigators presented at the 2000 Conference on Standards for Pre-school and Kindergarten Mathematics Education held in Washington D.C. May 15-17, 2000. This conference was funded by the National Science Foundation (ESI-98- 17540) and Exxon Mobil Foundation.

Principal Investigators also contributed articles in academic and professional journals and chapters to early childhood book publications during this period. These publications are listed in the Appendix of this document.

Other common methods of dissemination included distribution of information on listservs such as NARST and AETS and presentations on NAEYC, ETS, and university websites. All are counting on commercial publishers to assist in this effort.

What strategies are in place to facilitate adoption of materials by school districts?

Strategies are in place for heightening teacher awareness of the new materials. Projects used fliers and newsletters to recruit teachers during the pilot and field-test phases. Presentations at professional meetings and articles in journals, together with promotions by the publishers will be primary vehicles for publicizing the materials once they are available. In addition, classroom teachers were used on material development teams.

Principal Investigators in Project 2 are using the materials (CD ROM and videos) in university teacher preparation courses. The goal is to change prospective teachers' perception that appropriate pre-school work is play to a perspective that analyzes the thinking of the child in order to meet individual children's needs.

What strategies have been used to obtain a publisher?

Strategies to obtain publishers varied. One project relied heavily upon the PI's previous experience with publishers; a second indicated that having external editors to translate researchers' writing was a valuable step; a third hired a marketing consultant.

There were major challenges in finding publishers. A major concern of the projects was obtaining a publisher for their materials during the early stages of their grants, a requirement of their awards. It was suggested that NAEYC be approached like a publisher to gain their endorsement of materials. This does not solve the publishing problem but could open other doors to dissemination. It was suggested that a market study be conducted to answer questions about where and to whom materials should be marketed. Possible markets discussed included: niche publishers, children's museums, home-schooling organizations, and Head Start publishers.

One of the major challenges was that this group of projects was developing innovative materials rather than mainstream materials. It has been difficult convincing publishers to take a risk on materials that were not in the mainstream. Also, traditional textbook publishers have not been willing to market materials that include a variety of media beyond the text.

Projects discussed wanting to know more about NSF dissemination centers. Questions asked were:

- *"Exactly what do dissemination centers do?"*
- *"Where are they?"*
- *"How do we make connections?"*
- *"Do they work on public relations issues?"*

Two other questions were raised regarding NSF Local Systemic Change Projects (LSCs). Is it the intent of the LSCs to help with implementation of reform initiatives but does this apply to pre-school programs? Projects were also interested in whether the Learning and Teaching Centers being federally funded may be a possible avenue for dissemination and professional development.

The final challenge faced by the projects in regards to publishing was the number of buy-outs and mergers of publishing companies. This process often meant shifts in priorities for companies, and changes in contacts.

Summary. Successful implementation and dissemination are crucial components of this group of projects. All have devoted significant resources to developing manuals, videos, and CD ROMS to assure materials are used as intended.

A major challenge for projects has been obtaining a publisher. Marketing is often unfamiliar territory for educational researchers and most would benefit from expert advice in how to market innovative instructional materials in today's volatile publishing world.

Chapter 7—Stakeholder Involvement

Part A: Teachers

In what ways have teachers been involved in the materials development process?

Teachers are clearly a major stakeholder in any materials development program. They will be one of the primary end-users of the materials. It is essential that they be actively involved in the development of the materials. The degree to which teachers have been involved in the development of materials across the four projects in the Early Childhood Learning Community is variable, from reviewing and advising to field testing to actual development of materials. For some projects, current and former teachers were recruited as project staff.

For Project 2, teachers were an integral part of the development of the materials. This project created Teacher Professional Development Study Groups. In facilitating these groups, project directors were able to identify teacher assumptions about science and the teaching and learning of science. Teachers participated in "working conferences" in which they reviewed and critiqued the documentation/assessment materials being developed. The formulation of this project was based on earlier work by the PIs in which they had been meeting with teachers in elementary and preschool settings to explore classroom strategies for documenting children's science learning. This project also involved extensive videotaping of K-3 teachers both teaching in their classrooms and their interactions in PD sessions as they analyzed student work and how it reflected student science understanding.

Project 1 engaged teachers in a variety of ways in the development of the materials. Teachers collaborated early in the process by reviewing draft materials. PIs conducted case studies in individual classrooms, with teachers providing feedback about findings. Project PIs also conducted lessons with small groups while teachers observed and critiqued the lesson. Teachers also have used the materials, with PIs observing and providing feedback to teachers. Feedback from teachers on use of materials is also gathered by telephone, email, and on-site meetings. As part of another NSF-funded project, PIs conducted a needs assessment survey to identify issues important to preschool teachers in planning and implementing professional development.

Project 4 has used several classrooms as sites for "trying out" mathematics activities, as well as more formal field testing. These sessions were also videotaped for analysis of student learning and reaction. Teachers provide feedback to project staff about the efficacy of activities. Teachers will also be involved in developing vignettes and videos for use in training workshops for teachers and parents.

Project 3 conducted extensive "try out" activities in the initial phases of development of the instructional materials. Project staff, which has included former teachers, experimented with various activities and subsequent interactions in preschool and kindergarten classrooms. The teachers in these classrooms observed and provided formal

feedback. This teacher-feedback component was an important element in the early development phase of the instructional materials. Although teachers were involved in all phases of materials development, they were especially important in the formal field testing of the more fully developed materials.

In what ways are teachers involved in determining the impact of the materials on teaching and learning?

Materials have been developed and "tried out" in classrooms, with teachers playing roles from observing use of the materials to actually implementing them. Teachers have also been involved in more formal field testing of materials. In both instances, those developing the materials get feedback from teachers about ease of use of materials, effectiveness in using them with students, impact on the curriculum, impact on teaching strategies, and impact on students.

For most of the projects, formal student impact studies are either to be conducted in the final year of their projects or as future grant-funded efforts following actual development of the materials. Student impact studies, if included in the project, are peripheral or follow-up to the more formal field testing of the materials.

Part B: Parents

What are the challenges in designing instructional materials to involve parents?

The innovative K-12 mathematics and science materials developed with NSF funding over the past decade have departed in both content organization, presentation, and appearance from traditional text series. With a goal of engaging students in learning core concepts, lessons in these new materials don't have the familiar look of textbooks "when I [a parent] went to school." Designing materials with parents in mind must be a goal of today's instructional materials developers.

There are two important aspects to making materials "parent friendly." First, if schools are going to adopt and implement standards-based inquiry-oriented materials, they must bring parents along from the beginning in the adoption and implementation process. This involves communications between school and home as well as school and the non-parent community. Successful implementation can be thwarted by parents and community members who do not fully understand and appreciate the new materials. Thus it is incumbent on those developing materials to create support materials designed to help districts, schools, and teachers inform and engage parents and community in the implementation process. This should also include materials appropriate for school board members, who not only must approve purchases, but also respond to questions and complaints from their constituents.

The second important aspect to making materials "parent friendly" involves development of materials parents can use to support their children's learning. Parents are sometimes frustrated because they don't understand the new mathematics and science materials and

have difficulty "helping" their students with homework. Thus, parent support materials might include packets informing them of their child's mathematics and science activities, "homework" assignments, parent guides to helping their children with their homework and how to support their mathematics and science learning. These materials must be integral to the instructional materials. For early childhood materials, the emphasis might not be so much on homework as on tips and activities to support their child's learning of mathematics and science.

Parents, board members, and other community members must be advocates, not adversaries, when it comes to supporting standards-based inquiry-oriented curriculum and instruction. If efforts are made to engage them in the adoption and implementation process and provide them with materials to support their children's learning, they can easily become the program's strongest proponents. The challenge for materials developers is to build these parent support materials into the instructional materials as they are being developed. Parent support must not be an after thought or something done in a follow-up grant.

How have the materials been developed to engage parents in their child's learning?

The three early childhood mathematics projects have developed "home use" materials. Project 3 has family/caregiver letters in a teacher resources master's section. This project also has created special "home connection" activities to complement the core materials, connecting the mathematics learned in school with their home and community. Project 1 has created a parents version of the software that supports the mathematics program. Project 4 has also created various "take-home" activities related to in-school mathematics lessons.

Parents have also been involved in some projects during the actual materials development process. In Project 3, parents were invited to take on story telling roles with their children. In Project 4, a series of parent workshops was offered as part of the development process, in which parents learned about the nature of mathematics, how to engage their children in talking about mathematics, specific educational mathematics activities, and how to observe children engaged in mathematics.

What materials have been developed to inform parents or community members about the curriculum and instructional materials?

Project proposals referenced materials development activities to inform parents about the programs and how to support their children's mathematics learning. Examples include sample newsletters and other informational materials and "letters" for parents about the rationale for particular activities and parent nights to involve parents and children in mathematics activities. Although each instructional development package provides educational rationale, at present few materials have been prepared to help schools engage community members (non-parents) in the adoption and implementation process. This may not be as important for adoption and implementation of early childhood materials,

since many are used in pre-schools and may not necessitate the more formal K-12 adoption processes.

Summary: Teachers, parents, and community members are important stakeholders in both the development process and/or end product of a materials development project. The ECLC projects have involved teachers in a variety of appropriate ways in the development of their materials. This should add to the relevance, appropriateness, and ease of use of the materials.

Complementary to the classroom instructional materials, projects have included "home-school" packets and other information teachers can provide to parents. Materials to elicit support of parents, school or advisory board members, or other community members for adoption and implementation of materials is less evident.

Chapter 8—Evaluation and Student Assessment

How have materials been evaluated to determine effectiveness?

Field-testing. Field-testing was a major component of formative evaluation used by the projects. Challenges in field-testing included logistical problems (monitoring implementation in multiple sites), technical problems (finding the least obtrusive techniques for both video and audio-taping), and finding sufficient time to do analysis of tapes. Developing student assessments that will show student impact were also a challenge. Resources for doing broad field-testing across different populations were limited.

> *"A key element of the formative evaluation process is video-taping teachers field-testing the modules…so a difficulty in field-testing is scheduling—teachers can only implement the materials when a member of the program staff is available to videotape. Therefore, teachers are not entirely free to implement the curriculum as they choose."* (Project 3)

> *"In the fourth year, we hope to have resources for a national field test. A battery of assessments is to be developed for the national field test."* (Project 4)

Field-test settings. All of the projects attempted to field-test in a variety of settings. Rural settings were the most under-represented due to the high cost of testing at a distance from the home base of the development sites. For initial development and field-testing sites, the projects used both suburban and urban classrooms in close proximity to project sites. These included the greater metropolitan areas of New York City, Boston, Baltimore, and Buffalo. Public, private, and parochial schools were represented. Pre-schools included Head Start and day care settings. Populations of students were diverse in terms of ethnicity, first language, learning differences, and economics.

What progress has been made in identifying or creating assessments aligned with the new materials?

The ECLC projects expressed concern about NSF's requirement to use standardized instruments with their projects. This was most problematic for the projects that had a primary focus on spatial skills, since standardized tests measuring spatial skills at this level have not been identified. It was discussed at the conferences that although standardized assessments do not preclude authentic assessments, it was cautioned that as assessments at a state level have become more authentic, they have become more difficult to interpret because of derived scores.

> *"We're all for assessments but for little kids we should be doing observations, performance assessments such as kid's talk, and task or work samples. We should be talking about appropriate assessments instead of focusing on standardized tests."* (conference dialogue)

The December 2000 conference focused on early childhood policies. Much of the discussion revolved around testing policy. There was dialogue regarding bad policies being made about test use. The example was given of a large urban district that sent kids to summer school erroneously because of an error in scoring.

> *"What kind of teaching and learning results in long-time retention of knowledge and skills? Will these be measured by standardized tests?"* (conference dialogue)

It was the consensus that information on psychometric soundness of assessments is needed. It needs to be understood by both educators and by those in policy positions. To meet the NSF requirement, one project hired a consultant to identify the most closely aligned assessment instruments. Another project is looking at a different approach.

> *"Standardized testing is too constrictive. We are looking at an early childhood longitudinal study being conducted by NCES using computer adaptive testing* (America's Kindergarten)."

Standardized tests that were identified for use by these projects were the Bracken Basic Concept (Diagnostic) Scale (1984) and the Spatial Relations Test (Thurstone & Thurstone) 1965.

<u>What is the focus of your project evaluations?</u>

Formative evaluation was a major strategy used in the development of instructional and assessment materials. The main objective of the science project was to develop a system of assessment for student learning. A primary method of evaluation was gathering teachers together at working conferences and in study groups. These not only gave support to help teachers use the assessment method but also to analyze videos and discuss the assessment methodology in terms of ease of use, teacher satisfaction, and usefulness for improving instruction. Field-testing was another evaluation tool.

> "*The field-testing component included surveys, interviews, feedback from advisory board and current study group participants."* (Project 2)

Project 4 also relied heavily on teacher study groups to evaluate ease of use and teacher satisfaction during the field-testing phase. However, the core focus was on the impact on students.

> *"Formative evaluations at each of the development sites will be continuous and on-going during the development process. The effectiveness and usability of the materials—whether in the designed sequence or out of sequence, as freestanding activities—will be analyzed at the child, classroom, teacher/daycare provider, and parental levels. A wide assortment of data gathering techniques (including classroom observation, clinical interviews and testing with children, interviews with teachers and parents) will be employed by the design teams at each site. Our psychological research has given us considerable experience in observing,*

testing, and interviewing the children and in observing classroom activities conducted by the teachers and interviewing them as well." (Project 4)

Clinical interviewing of children was used as an evaluation tool in the projects. At the second learning community conference, the Principal Investigator of Project 4 (a recognized expert in clinical interviewing of children) gave a presentation on the process. This method of assessment is intended to give understanding of the child's thinking processes. Although a powerful assessment technique, it requires considerable expertise on the part of the interviewer in regards to questioning techniques and skill in making appropriate inferences that are useful in improving materials and/or instruction.

Multiple measures were used to measure impact on students. In addition to clinical interviews, projects used observation and project-developed assessment instruments.

"Criterion-referenced instruments are being developed to assess student learning that is performance based and tests knowledge as applied to new situations." (Project 3)

Videotaping of classrooms has been an essential component of the formative evaluation process for three of the projects. Tapes were analyzed at a student, classroom, and teacher level. Analysis was done by project staff, graduate students, and classroom teachers. In some cases, project evaluators also took part in this process. Student products were also analyzed. This is a major component of Project 2's assessment system. Project 4 developed rubrics for this process.

Two of the projects are using a research model for the summative evaluation of the effectiveness of the materials.

"Comparisons of classrooms will be used to test student outcomes in the 4th year." (Project 3)

"The effectiveness of the entire program will be evaluated during the field test phase and at the completion of the development phase. We will employ a variety of evaluative methods to compare the progress of children in our program with matched children in control sites. We will administer to individual children simple tests covering the material in the various components of the program; conduct clinical interviews with individual children; collect children's "products" (their constructions of whatever sort), administer a nationally normed test of early mathematics ability, interview teachers concerning their level of comfort with the program, and conduct observations of the actual implementation of the program and children's work with it." (Project 4)

External evaluators were used by the projects in similar ways. They were used both to document the process of development and the impact on student learning. Advisory boards were also used to give feedback on developed materials. Advisory boards included nationally recognized experts and classroom teachers.

> *"I observed the process of development. I designed the ease of use and teacher satisfaction questionnaires but my primary focus has been on documenting potential impact of the product on students, both in terms of their attitudes and their learning." (Project 3 Evaluator)*

The role of the external evaluators among projects varies from being an integral part of the development team to being an outside sounding board. For those who are an integral part of the team, involvement includes attendance at team meetings, interviewing key players in the development of materials, classroom observations, and developing assessment tools. For those evaluators who play more of a sounding board role, involvement includes looking at the materials as they are developed and assessing their congruence with the goals of the project, working with study groups on teacher development, and attending conferences for teachers in the project.

> *"I participated in project meetings as an observer and offered suggestions when consulted. I conducted informal interviews with staff about assessment of the project's progress. My feedback when sought was welcomed and incorporated into the collective wisdom."* (Project 3)

Discussions at learning community conferences revealed that evaluation plans are articulated around project objectives. A focus of evaluators has been to monitor application and generalizability. This is complicated by budget constraints that have affected the projects' abilities to use control groups during the development phase. Equity and developmental-appropriateness have also been important issues.

Project directors agree that the impact of the instructional and assessment materials developed in these projects will rest in both the changes in teachers and changes in students. Teacher study groups and classroom observations are important methods used in these projects to measure the impact on teachers' instruction. Evaluators have expressed the need to determine if the assessment processes in the projects are used effectively by teachers and whether they accurately reflect children's learning. Project 2 places a primary focus on study groups as both a professional development tool and an evaluation process used in the development phase. Group discussions are very important in this project since the science assessment is conducted through social interaction. Focus is on "what do you want kids to learn and what would be the best documents to reveal growth in this area?" Central to study groups was the idea of improving the lesson.

Some of the evaluation questions that continue to challenge developers are:

- *"How do we distinguish the differences between evaluation of program impact and individual lesson effectiveness?'*
- *"What level and type of assessment can be done during the process of material development?*
- *"Students are perhaps subjected to many renditions of the materials during the development phase so will the 'outcomes' be the same as when the final product is used?"*

How were the material development process and procedures documented?

To inform future materials development projects and provide both formative and summative data to projects, it is necessary to do extensive documentation of the development process. This group of projects used multiple methods. A major component of documentation across projects was videotapes. Documentation included analysis of the tapes as well as teachers' reflections after each lesson. One project documented the process of searching for publishers. Work with outside consultants was another important form of documentation.

> *"Videos have been made each time new materials are used in the classroom. Discussion of the lesson has also been taped. Daily reports from teachers are recorded. There are computer records of all drafts of the development process. In addition, assessment of children has been videoed."* (Project 4)

How have student assessments been integrated into the instructional materials?

Challenges in embedding assessment strategies into early childhood programs. In the second conference, extensive dialogue took place around issues of embedding assessment strategies into early childhood programs. Self-regulation and motivation of children were identified as important assessment issues. A consultant to Project 3 gave a presentation on self-regulation and the ramifications this had for assessment. Dialogue could be separated into two categories: (1) problems encountered in early childhood assessment and (2) important issues and effective methods to consider in early childhood assessment.

At the second conference, participants created a list of commonly encountered problems in assessment of very young children. The list follows:

Policy problems

- As the pressure grows for student achievement as measured by standardized tests, teachers fear that the curriculum will be pushed down to lower grade levels.
- Policymakers are looking for simple ideas to wrap around such as central tendencies. In some areas, every school in the county is ranked in newspapers according to performance assessments. Reliability of tests in early childhood is always an issue, making these policies questionable. *"Testing with young children is notoriously unreliable. You have to deal with the fact that the way you find out what they know is by watching them and by talking to them…so that is what was built in."* (Project 3)
- For the public, congress, and NSF, evaluation is an expectation and need. We must know about changes in teacher practice, and change in curricula.
- This accountability focus is echoed by GPRA (Government Performance and Results Act), which mandates that accomplishments be stated in terms of outcomes.

- NSF needs credible information that kids are learning. Do the materials make a difference? Are they better than other materials? Are the materials being used effectively? NSF needs evidence for the public in order to prove that tax dollars are being well used.

Professional development needs

- There are no common certification requirements across states for Pre-K teachers. Consequently they are often not educated about mathematics, science, or assessment.
- If children are not thinking in ways expected, you may miss their growth. This calls for more professional development of pre-school teachers in assessment methods, and developmental stages of learning.

Characteristic problems in early childhood assessment

- Assessment is complex and child-centered.
- We need to know stages of development in measurement (counting, conservation, and computation). How do we handle delayed development?
- Children generate knowledge from experience. Understanding comes from experience in the world. Sometimes this "stealth learning" is difficult to assess.
- Not enough is known about how young children learn mathematics and science.
- Much assessment is getting a notion of the group rather than at an individual level to inform instruction. "What do you do to take assessment to an individual level? Teachers must assess in a global way and yet focus on individuals in a deeper way."
- Transfer to off-task activities is common in very young children.
- Looking for group patterns is important but how do we assess these patterns?
- "Our project provides practice in visualizing. How do you measure it?"
- Difficulties in assessing young children include separation from parent, familiarity with testing materials, attention, emotional state, motor compliance, and motivation.

ECLC participants were concerned about the possibilities of losing authentic assessment at the early childhood level and the "push-down" of student achievement (i.e. kindergarten students to take the 3rd grade test). They believe this may happen because of the policymakers' focus on standardized outcomes and NAEYC'S Presidential Forum on Accountability that pushed for data that is acceptable to boards, states, and government agencies. A need for other methods of accountability was expressed. This was seen as a critical issue.

What are important assessment issues and effective strategies?

Projects not only identified problems in early childhood assessment but brainstormed ideas about effective strategies. Having recognized experts in assessment in the group of conference participants made this a particularly valuable process. It was discussed how research on assessment should center on how children achieve, how children learn to learn, and how to measure these approaches over time. Identified strategies follow:

Professional development issues

- Vignettes of kids taking tests are useful but knowledge of how to use videos for assessment in a practical way (systematic sampling, group analysis, etc.) is the important issue.
- Teacher implementation issues are critical.
- It was suggested that the creation of assessments be closely linked to the professional development of teachers in order to de-mystify the process and link observations with meanings.

Standardized testing

- Exploring feasibility of group tests with Pre-K would be useful.
- Children do hypothesize, make categories, etc. Standardized testing doesn't generally capture that. Authentic assessment methods are needed for looking at patterns of thinking.

Assessment strategies

- Inclusion of multiple measurements is particularly important with young children. Multi-modality should be used for both student assessment and evaluation of program effectiveness.
- Assessment tasks must be designed to reveal what the child understands. Tasks have to be generative.
- It is important to have authentic assessment with integrative problem solving. In measuring problem solving and critical thinking in children, it is important to understand how they reason and think.
- There is a need to do more than just observe if you want to know how kids are thinking. You need clinical interviews, along with observation and tests.
- Assessment needs to be independent from accountability.
- Deep understanding of theory is necessary. The deeper the understanding of the task, the better chance to develop good assessment.
- Teachers must think of inquiry as assessment. "Teachers do not understand this. They say, 'what shape is this?' rather than really finding out what the child knows and can do with shapes."
- It is important to understand the relationship between mathematics and science and what that means for assessment.
- Because of a wide range in developmental levels in pre-school environments, individualizing assessments is pertinent.

Project-based Issues

- Process-based measures that all projects are trying to achieve are needed. This might include time on task, communication, patterns in group process, and language development.
- Group assessment should be explored as a way to judge progress and impact, However, it is useful for people to understand the unique aspects of each project thus making common evaluation problematic.
- To make the best use of resources, sampling strategies need to be considered.

At conferences and site visits, Projects reiterated the idea that early childhood assessment cannot be a one-time process but needs to be an on-going multi-method process.

> "*Young children don't learn from one lesson. They need to actively participate; they need to think about it. Response to an initial lesson does not necessarily show what they know…I want to think about developmentally appropriate assessment related to the standards but understand how it is that a child learns and how they should be doing the assessment. Teachers should be assessing children daily by observation and record keeping and provide a series of forms that they could put into children's portfolios and then review over time and observe children's progress. Assessment of young children's progress needs to be ongoing, strategic, purposeful, and yet not too time consuming."* (Project 3)

Among these Projects, observation, questioning, and listening to children are common methods used to assess children. Projects were committed to understanding the depth of children's understanding. This raises the issue of professional development. Will teachers have sufficient professional development to use the materials effectively?

> *"Generalizability issues are always apparent. Becoming a better diagnostic listener is not an easy process."* (Project 2)

<u>What types of assessment strategies align best with early childhood materials?</u>

Assessment strategies among projects had more commonalities than differences. They focused on individual assessments that would reveal children's depth of understandings. It was also a common belief that assessment should be an embedded ongoing process.

> *"Assessments will be based on the progress that the children make relative to their own developmental levels. The teachers will assess the children's progress at regular intervals, and performance-based assessments will be provided to be included within each child's portfolio. In addition to the measures designed specifically to assess each lesson, we will also provide process-based assessment tools, designed for use at regular intervals throughout the year."* (Project 3)

> *"Video- tapes of classrooms are used to determine childrens' understandings, levels of participation, and level of connection to the materials. Analysis is done*

to identify differences between genders, ethnic groups, as well as individual differences." (Project 3)

"Profiles of each child and each activity have been documented and analyzed. Children are videotaped as they are assessed. Tapes are analyzed for the behavior/strategy used to solve problems, the understanding of the concept, vocabulary used by the child, and how well knowledge has transferred." (Project 4)

How has evaluation data been used?

The primary formative evaluation data used by the four projects was in the field-testing during the materials development phase.

"I observed the field-testing in the materials development phase, which concerned the quality of the materials being developed. The pilot testing of the evaluation instruments is the phase we are in now. This phase concerns the validity of the measures to be used and the procedures for data collection." (Project 3 Evaluator)

Pilot testing, after the draft of materials is complete, is designed to provide summative data to measure the impact on students. A research model is used for this part of the materials evaluation.

"The materials were revised weekly as a response to field-testing in the classrooms. The pilot testing is not designed to be a formative evaluation for gathering feedback on how to revise the materials. Rather it is to document the potential impact on students." (Project 4)

Summary. Assessment of young children is a complex task, requiring deep knowledge of children's developmental levels. Pre-school children (3-5 years old) demonstrate a broad range of cognitive, linguistic, and physical abilities that change rapidly. This characteristic requires assessment that is on-going and cumulative. Multiple sources of evidence are needed and methods of assessment must be sensitive to linguistic, gender, cultural, and cognitive differences among children.

Teachers must have access to quality professional development in assessment practice. Assessment expertise will enable teachers to improve assessment, advance student learning, and plan for intervention at an individual level.

Chapter 9—Resources

What are the staffing needs for the materials development process?

Experience. The Principal Investigators of the four instructional materials development projects involved in the ECLC have a wide range of expertise. PI's hold Doctorates in child psychology, developmental psychology, mathematics education, elementary education, and communicative disorders. All are widely published in their respective fields. In addition to journal articles, book chapters, and books, PI's have been part of writing teams for mathematics textbooks and written software programs for early childhood mathematics. Published topics include:

- Clinical interviewing of children
- Piaget
- Gender differences in mathematics
- Visual-spatial abilities
- Problem-centered classrooms
- Interpreting student work
- Classroom documentation of young children's science knowledge
- Learning and teaching of geometry
- Teaching creativity with computers
- Constructivism in early childhood mathematics
- Parental influences on children's mathematics learning
- Assessing mathematical thinking
- Communicative processes in mathematics investigations

PIs have been active on national committees and panels in the field of mathematics and science education such as NCTM and NSTA. They have served as consultants to educational institutions, school reform initiatives, industries, and standard setting committees. All are either presently involved, or have been in the past, in the academic preparation of teachers at universities and colleges. Two presently are research scientists at a national assessment organization.

What skills and backgrounds are valuable for staff involved in the materials development process?

Projects have engaged experts in computer science education, equity, classroom observation, integration of literature and mathematics in the classroom, administration and development of in-service programs, national science and mathematics standards, and science content areas. The majority of staff members hold Doctorates in the fields of curriculum and supervision, mathematics, science, and computer technology. Technical skills in videography were important for all four projects as this was the most common method for conducting formative evaluation during the field-testing stage. Skill in CD ROM production was particularly valuable to Projects 1 and 2. Skills and experience with software development were important for Project 1.

In addition to the highly skilled and experienced staff, the depth of skill and expertise represented on their advisory boards also enhanced projects. Examples of expertise and experience include:

- Director of professional development for NAEYC
- Co-principal Investigator in the New York State Systemic Initiative on K-8th grade mathematics, science, and technology education
- Developers of national assessment systems
- Co-Director of the Center for Urban Science Education Reform
- Writer and illustrator of children's books
- School psychologists
- Experts in diagnosis and adaptation of curricula for children with special needs, studying student thinking about space and geometry, use of technology for promoting professional growth
- Professors of child development, educational psychology, curriculum and instruction, mathematics education, computer science, and early childhood education
- Mathematics coordinator for the laboratory schools of the University of Chicago
- Software developers
- Internationally recognized expert in technology use in education

In addition, evaluators hired for project evaluation augmented the resources available to projects. By contributing their fields of expertise in the formative evaluation process, projects were strengthened. The specialized fields of expertise include: ethnic and racial diversity, gender equity, classroom observation, socio-economic factors in student achievement, impact of educational technology on achievement, and school reform.

Projects found staffing challenging because of budget constraints. A common strategy was to use pre-school and early elementary teachers in addition to graduate students in education (many former teachers). The use of classroom teachers was a powerful contribution to projects. Through their input, materials will likely be more "teacher friendly" and have greater implementation fidelity.

What are budget considerations for the materials development process?

In the present accountability era, PIs are keenly aware of the need for documentation of both product development and impact. Assessment and evaluation are major budget considerations for this group of projects.

> *"Funding only pays for barebones assessment. The budget is weak in paying for adequate technology, dissemination, professional development and analysis."* (Project 4)

> *"Identifying sites in close proximity to project development sites that represent a variety of demographics to do initial pilot testing of materials is challenging. This is important to minimize travel time and costs."* (conference dialogue)

> *"Our proposal for a more detailed process evaluation was cut. Formative evaluation was totally eliminated. We pooled all our resources to do an impact evaluation."* (Project 3)

A primary consideration, of course, is the cost for development of the product. This is particularly true of projects that integrate technology. To make the materials accessible to all, significant financial resources are being used for adapting materials for children with special needs.

> *"Video editing consumes a great deal of time—quality film production is an important issue."* (Project 2)

> *"Software development is extremely expensive. Delays in production and delays in copyrighting issues can be costly."* (Project 1)

> *"Making adaptations to meet the needs of special needs students takes time, special expertise, and resources."* (conference dialogue)

Another major concern is professional development. The grants for these projects do not include funds for professional development after the materials are developed. Publishers are also reluctant to support this. Although some professional development is provided in the pilot-testing stage, this is a major concern of developers. It is amplified in early childhood programs because of the wide variance of professional preparation among pre-school teachers.

> *"How do you build in enough financial support for adequate professional development of teachers?"* (Project 3)

<u>What have been the challenges in meeting the time frame identified in the original grant for developing materials?</u>

At the final conference, these challenges were discussed. Challenges in meeting time frames revolved around four main issues: publishing, legalities and bureaucracy, use of outside contractors, and assessment and evaluation.

Two of the projects, in particular, said finding a publisher took considerably more time and resources than had been projected. In one case, a marketing consultant was hired to assist in this process. Because these projects involved innovative curricula, publishers needed to be convinced of the market for the product. Another issue was allowing time for publisher's requests for revisions. The earlier the publisher becomes involved the project, the less likelihood there is for complete revisions. However, it is more difficult to market the product to a publisher in the early development stages unless the Principal Investigators have a proven track record of instructional materials development.

Legal issues and university procedures can stall the project. It is ideal if these issues could be resolved before the project begins. In one case, there was controversy on copyright issues between the university, the software developer, the funder, and the

project development team that significantly delayed the project and raised the development costs.

Use of outside contractors can also significantly delay the project. If field-testing or pilot-testing is dependent on an outside contractor producing a product such as software, the project can encounter a major roadblock.

Summary.

Development of early childhood materials requires a development team broad in expertise and experience. Technical skills and the involvement of classroom teachers are also crucial elements. Besides expertise in early childhood development, pedagogy, and the content areas; technical skills in administration, evaluation, supervision, video documentation, and computer technology are key components for successful development of materials.

Successful dissemination of the materials rests heavily on substantial evidence that the materials are educationally sound and have positive impact on student achievement. This points to the critical need for evaluation and assessment to be funded adequately. In addition, time and financial resources need to be built in for adequate field and pilot testing in diverse settings (both urban and rural).

Publishing and marketing new early childhood educational materials is costly in both time and financial resources. The resources needed for this endeavor should not compromise the quality of the materials development process.

Chapter 10—Conclusions and Observations

A review of the information gathered by learning community facilitators has resulted in the following conclusions related to issues affecting early childhood materials development. Many issues are, of course, relevant to preparation of all curriculum and professional development materials. Additionally, there are comments about the functioning of grantee cross-site learning communities.

It is important for readers to note that the learning community project was not an evaluation of individual materials development projects. Each project had its own evaluator who produced evaluative data according to grant specifications. The purpose of the evaluation component of the learning community was to study cross-project issues affecting materials development.

Conclusions Based on Common Cross-Project Issues:
Materials Development

- Development of instructional materials requires more than just creating educationally sound classroom lessons or activities and the associated student materials. If the new materials are to be successfully implemented in schools and other educational settings, serious consideration has to be given to several issues prior to and during the development of the materials. This includes developing user-friendly teacher guides; parent guides to support their child's learning; rationale for parents, educational decision-makers, and community members about the value and efficacy of the materials; optimal plans and support materials for professional development of teachers and other users of the materials; and student assessment and program evaluation tools. So much time and energy can go into development of the core materials that these important support materials sometimes become an afterthought. An important function of the learning community was to identify, prioritize, and engage in in-depth discussions of selected issues.

- All projects place alignment with national mathematics and/or science standards as a high priority. In addition to aligning their own projects, all have contributed their expertise and experiences to the development of national standards designed specifically for pre-school education. Projects are grounded in well-recognized educational theories and in extensive research conducted previously by Principal Investigators. By focusing on alignment with national standards and child development research, the projects are preparing materials that lay a solid groundwork for children as they enter early elementary grades.

- Those engaged in development of instructional materials must be cognizant of the diverse settings in which the materials might be implemented. Equity and diversity issues must be addressed as the materials are being developed. This includes not only addressing issues related to students, but diversity of knowledge and skill levels of teachers. This is a particularly challenging issue for those developing materials for pre-school use, given the wide range of differences in cognitive and socio-cultural

experiences of students, parents, and teachers. The challenge is compounded by the significant differences in pre-school teacher quality and pre-school environments.

Although field-testing was an important activity for projects, financial constraints prohibited the projects in the learning community from conducting more extensive field tests that might have included a more representative sample of settings. Most field-testing took place in urban settings convenient to the home bases of the projects. Materials may not have had adequate testing to fully address the wide range of equity issues.

- There are several important stakeholder groups relevant to development of instructional materials: students, teachers, parents, educational decision-makers, community members, and project funders. All must be given serious consideration as materials are developed. Clearly children have been intimately involved as projects piloted and field-tested their materials. Teachers were involved in critiquing materials as they were being developed and in field-testing selected materials. Teachers or former teachers also served as staff members on some projects. In one project, teacher study groups served as a core development strategy for the materials. Teacher involvement adds to the relevance, appropriateness, and ease of use of the materials.

  To a lesser extent, parents have also been involved in the materials development process. Especially during the early years of a child's formal education (including pre-school), parents are likely to be more intimately involved in their children's learning. Thus, it is important to engage parents in the development process, such as critiquing or field-testing the parent components created by the projects (i.e., "home-school" packets).

  Creating complementary materials designed to elicit support of parents (not parent support materials to assist their child's learning), school or advisory board members, or other community members for adoption and implementation of materials may be an area that needs greater emphasis among developers of innovative instructional materials. This might include creating user-friendly materials that provide a rationale for the value and efficacy of the materials.

  Grant funders have particular expectations and procedures that must also be considered by materials developers. This has been particularly challenging for the early childhood mathematics materials development projects because there have been so many changes in program officers over the course of the projects.

- If materials are to be effectively implemented as intended by the developers, they must also provide guidelines and support materials for professional development of teachers and others who will be using the materials. Projects in the learning community have devoted significant resources to developing manuals, videos, and CD ROMS to maximize the likelihood of implementation as intended. It is important that this work be done in concert with the development of the materials--during "try-outs" and field-

testing so that training materials are not an afterthought. Teachers who are inadequately prepared to use the materials negatively impact effective implementation.

• In the current political climate in which schools function, student assessment is a reality that all educators must address, including materials developers. Funders, national and state decision-makers, school administrators, teachers, parents, and others want to know what students are learning. Any viable instructional materials must address issues of student assessment and learning. There are two dimensions for materials developers: evidence that their materials actually improve student learning and assessment procedures that teachers can use to measure student learning.

  Assessment of young children is a complex task, requiring deep knowledge of children's developmental levels. Identifying existing "tests" or creating new assessment instruments and procedures has been, perhaps, one of the most challenging tasks for the mathematics materials development projects in the learning community. If projects are to show the effects of their materials on student learning, they must have evidence acceptable to their various audiences.

  In learning community discussions, participants concluded that assessment of young children must be on-going and cumulative, requiring more than traditional tests, since pre-school children (3-5 years old) demonstrate a broad range of cognitive, linguistic, and physical abilities that change rapidly. Multiple sources of evidence are needed and methods of assessment must be sensitive to linguistic, gender, cultural, and cognitive differences among children.

  Instructional materials must include assessment instruments and procedures useful to teachers. Teacher training on use of the instructional materials must also include use of the assessment system. Assessment expertise will enable teachers to improve assessment, improve instruction, advance student learning, and plan for intervention at an individual level.

Conclusions Based on Common Cross-Project Issues:
Grant Implementation

• Without exception, projects indicated that to develop high quality and effective instructional materials required more time than expected--in most cases, more time than proposed in the grant application (most have requested no-cost extensions). Short timelines clearly stretch staff and budgets. When computer technologies are incorporated, the time commitment is even greater. If timelines are too short, materials beyond the core lessons and activities may not receive as much attention as needed, thus necessarily compromising the quality, effectiveness, and comprehensiveness of the materials.

• An expectation of the National Science Foundation was that all learning community projects would obtain a publisher for their materials. This has proven to be a major challenge for some of the projects given today's volatile publishing world. It has also

required significant time and financial commitment on the part of Principal Investigators. Although some project staff had previous experience with publishers, locating and negotiating with publishers requires special expertise unlike that required for development of educationally sound instructional materials.

Problems unique to publishing of pre-school materials were also identified. Not all the materials would be considered full curricula, but curriculum support materials. Those requiring computer applications also presented special problems. Publishers are unsure how these materials can be disseminated effectively to the diverse pre-school market.

As a funder for developing materials, NSF must also take some responsibility for seeing to it that materials get a fair chance for widespread dissemination. Considering that most materials developers (at least as represented by this learning community) lack the levels of marketing expertise necessary, NSF resources should be used to support individual projects in their pursuit of publishers.

- Materials development projects have unique staffing issues. A great variety of expertise is necessary for materials development—content knowledge, child development and pedagogical expertise, public relations and facilitation capacities, organizational and coordination skills, graphics and production talents, budgeting and administrative skills, evaluation knowledge, and marketing expertise. Within budget constraints, projects must find the right combination of knowledge and skills at the right time in the materials development process. Projects relied on a small core staff, graduate students, and internal and external consultants. Occurrences of staff turnover put strains on budgets and timelines.

- The materials development projects are clearly frustrated and often handicapped by the high turnover of NSF program officers. In the course of this learning community, there have been five different program officers (over an approximately four-year period). Both the individual projects and the learning community need consistent expectations and support from NSF program officers to maximize the investment made by the Foundation.

- The role of project evaluators has been variable and sometimes uncertain. Defining a role for evaluators in materials development projects is problematic. What is their role: Documentation and monitoring of activities? Evaluating efficacy of project implementation? Reviewing and critiquing draft materials? Field testing? Evaluating impact? What is the purpose of evaluation—Program improvement? Accountability? Or both? Although NSF requires an evaluation of materials development projects, parameters for such an evaluation are unclear.

Comments About the Functioning of Cross-Project Learning Communities

The following observations and comments relate to the operation of the early childhood learning community.

- Bringing together NSF grant-funded projects with similar goals to address common issues, share ideas, and problem-solve collectively can be a powerful way to strengthen individual projects as well as help to maximize the NSF investment. Skepticism and reluctance to participate in conferences among the learning community projects was evident at the outset of the learning community project. Some were unclear about the purpose of the learning community. At first, the materials developers saw themselves as competitors. Some saw the cost of learning community participation as a burden on their project budgets (even though NSF required these costs be included in their original budgets). Although there was still skepticism at the end of the first conference, some concerns did subside. Some interaction of participants occurred between conferences. The second conference focused squarely on an issue pertinent to all of the projects—measuring student learning. This resulted in lively discussions, an increased camaraderie among participants, and recognition that PIs and projects might be able to help each other. By the end of the final conference, several participants indicated their pleasure with the value of the learning community. Based on experiences of the learning community facilitators in other cross-site projects, this is a fairly natural progression. Unfortunately, by the time the cross-project sharing has reached its optimal level, the learning community ends.

- There are several factors that impact the effectiveness of a learning community or any facilitation of cross-site sharing. It is important that projects in the group have similar goals and objectives to facilitate identification of common issues and problems. Expectations for participation in the learning community must be made explicit to grantees and adequate funds made available for them to participate without handicapping their project budgets. Ideally, the start-up and end-point of the learning community should be congruent with the beginning and end points of the projects involved. Direct involvement of the NSF program officer is also essential, not to manage the learning community, but to provide NSF perspectives and guidance.

APPENDICES

Appendix A: Bibliography

Appendix B: Consultants and Special Presenters to Early Childhood Leaning Community Conferences

Appendix C: Early Childhood Learning Community Facilitators

Appendix D: Agendas from Early Childhood Learning Community Conferences

APPENDIX A: BIBLIOGRAPHY

Assessment

Bennett, G. K., Seashore, H. G., & Wesman, A. G. (1992). Differential aptitude tests: Technical manual (5th ed). New York: The Psychological Corporation.

Bracken, B. A. (1984). Bracken basic concept scale, Revised. San Antonio, TX: Harcourt Brace Educational Measurement.

Bredekamp, S. & Rosegrant, T. (Eds.). (1995). Reaching potentials: Appropriate curriculum and assessment for young children. (Vol. 1). Washington, D. C.: National Association for the Education of Young Children.

Bredekamp, S. & Rosegrant, T. (Eds.). (1995). Reaching potentials: Transforming early childhood curriculum and assessment. (Vol. 2). Washington, D. C.: National Association for the Education of Young Children.

Bright, G. & Joyner, J.M. (1998). Classroom assessment in mathematics: Views from a National Science Foundation working conference. New York: University Press of America.

Falk, B. (2000). The heart of the matter: Using standards and assessments to learn. Portsmouth, N. H.: Heinemann.

Ginsburg, H. P., Jacobs, S.F., & Lopez, L.S. (1998). Flexible interviewing in the classroom: Learning what children know about math. Boston: Allyn Bacon.

Thurstone, T. G. & Thurstone, L. L. (1965). Primary mental abilities test: K-1. Chicago: Science Research Associates.

Wright, W. L. (1994). Listen to the children: Observing young children's discoveries with the microcomputer. In J. L. Wright & D. D. Shade (Eds.), Young children: Active learners in a technological Age. (pp.3-17). Washington D. C.: National Association for the Education of Young Children.

Early Childhood Education

Bowman, B. T., Donovan, M. S., & Burns, M.S. (Eds.). (2001). Eager to learn: Educating our preschoolers. Washington, D. C.: National Academy Press.

Bronson, M. (2000). Self-regulation in early childhood: Nature and nurture. NY: Guilford Press.

Casey, M. B. & Tucker, E. C. (1994). Problem-centered classrooms: Creating lifelong learners. Phi Delta Kappan, October, 139-143.

Clements, D. H. & Battista, M. T. (1990). Constructivist learning and teaching. Arithmetic Teacher, 38, (1), 34-35.

Dahlberg, G., Moss, P., & Pence, A. (1999). Beyond quality in early childhood education and care: Postmodern perspectives. Philadelphia, PA: Falmer Press.

Frede, E. C. (1995). The role of program quality in producing early childhood program benefits. The Future of Children, 5, (3), 115-132.

Helm, J. H. & Katz, L. (2001). Young investigators: The project approach in the early years. NY: Teachers College Press.

National Institute on Early Childhood Development and Education. Ed. (2000). New teachers for a new century: The future of early childhood professional preparation. Washington D.C.: U.S. Department of Education.

Pellowski, A. (1990). The world of storytelling: Art and technique. New York: R.R. Bowker.

Powell, D. (1991). Early childhood as a pioneer in parent involvement and support. In S. L. Kagan (Ed.), The care and education of America's young children: Obstacles and opportunities. (pp. 91-109). Chicago: University of Chicago Press.

Resnick, L. (1989). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Salinger, T. & Chittenden, E. (1994). Analysis of early literacy portfolio: Consequences for instruction. Language Arts, 71, (6) p. 446-452.

Shonkoff, J. P. & Phillips, D. A. (Eds.). (2000). From neurons to neighborhoods: The science of early childhood development. Washington D.C.: National Academy Press.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University.

Vygotsky, L. S. (1986). Thought and language (A. Kozulin, Trans.) Cambridge, MA: The MIT Press.

Vygotsky, L. S. (1994). The development of academic concepts in school aged children. In R. Van Der Veer & J. Valsiner (Eds.), The Vygotsky reader (pp. 355-370). Oxford, UK: Blackwell.

Yelland, N. J. (2000). Promoting meaningful learning: Innovations in educating early childhood professionals. Washington, D. C.: National Association for the Education of Young Children.

Equity Issues

Allen, B. (1991). The influence of contextual factors on Afro-American and Euro-American children's performance: Effects of movement, opportunity, and music. International Journal of Psychology, 26, 373-387.

Lachat, M. A. (2000). Standards, equity and cultural diversity. Providence, R.I.: Northeast and Islands Regional Educational Laboratory, Brown University.

Michigan Department of Education & North Central Regional Educational Laboratory. (1998). Connecting with the learner: An equity toolkit. Oak Brook, IL: North Central Regional Educational Laboratory.

Steffe, L. P. (1996). Socio-cultural approaches in early childhood mathematics education: A discussion. In H. Mansfield, N.A. Pateman, & N Bednarz (Eds.), Mathematics for tomorrow's young children. (pp. 79-99). Dordrecht, Netherlands: Kulwer Academic Publishing.

Mathematics & Science

Baroody, R. (1987). Children's mathematical thinking. New York: Teachers College Press.

Casey, M B., Colon, D., & Goris, Y. (1992). Family handedness as a predictor of spatial ability among minority girls in a math-science training programs. Brain and Cognition, 18, 88-96.

Casey, M. B., Nuttal, R. L., & Pezaris, E. (1997). Mediators of gender differences in mathematics college entrance test scores: A comparison of spatial skills with internalized beliefs and anxieties. Developmental Psychology, 33, (4), 669-680.

Chittenden, E. & Meier, D. (1985). Science teaching: Creative alternatives. Curriculum Review, 25, (1), 76-77.

Clements, D. H. & Battista, M. T. (1992). Geometry and spatial reasoning. In D. A. Grouws (Ed.), The handbook of research on mathematics teaching and learning. New York: MacMillan.

Clements, D. H. & McMillan, S. (1996). Rethinking "concrete" manipulatives. Teaching children mathematics, 5, 270-279.

Ginsburg, H. P. (1996). Toby's math. In R. J. Sternberg & T. Ben Zeev (Eds.), The nature of mathematical thinking. (pp. 175-202). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Ginsburg, H.P. & Baron, J. (!993). Cognition: Young children's construction of mathematics. In R. J. Jensen (Ed.), Research ideas for the classroom: Early childhood mathematics. Reston, VA: National Council of Teachers of Mathematics.

Ginsburg, H. P., Klein, A., & Starkey, P. (1997). The development of children's mathematical thinking: Connecting research with practice. In I. Siegel & A. Renninger (Eds.) Handbook of Child Psychology: 5th ed., Vol.,4 Child Psychology and Practice. NY: John Wiley & Sons.

Ginsburg, H. P., Pappas, S., & Seo, K. H. (2001). Everyday mathematical knowledge: Asking children what is developmentally appropriate. In S. Golbeck (Ed.) Psychological perspectives on early childhood education. Mahweh, NJ: Lawrence Erlbaum Associates.

Ginsburg, H. P., Balfanz, R., & Greenes, C. (1999). Challenging mathematics for young children. In A. Costa (Ed.) Teaching for intelligence. (pp. 245-258). Arlington Heights, IL: Skylight.

Greenes, C. (1999). Ready to learn: Developing young children's mathematical powers. In J. Copley (Ed.), Mathematics in the early years. (pp. 39-47). Reston, VA: National Council of Teachers of Mathematics.

Resnick, L., Bill, V., Lesgold, S., & Leer, N. (1991). Thinking in arithmetic class. In B. Means, C. Chelemer, & M. Knapp (Eds.), Teaching advanced skills to at-risk students. San Francisco: Jossey-Bass.

Richardson, K. & Salkeld, L. (1995). Transforming mathematics curriculum. In S. Bredekamp & T. Rosegrant (Eds.) Reaching potentials: Transforming early childhood curriculum and assessment. Washington, D. C.: National Association for the Education of Young Children.

Rubenstein, R. N. (1995). Facilitating change in school mathematics: A handbook for leaders. Lansing, MI: Michigan Council of Teachers of Mathematics.

Schiro, M. (1997). Integrating children's literature and mathematics: Children as problem-solvers, literary critics, and meaning-makers. New York: Teachers College Press.

Sherrill, C. (1994) Problem-solving adventures: Mathematics through literature and music: Journey to the other side. Mountain View, CA: Creative Publications.

van Hiele, P. M. (1986). Structure and insight. Orlando, FL: Academic Press.

Welchman-Tischler, R. (1992). How to use children's literature to teach mathematics. Reston, VA: National Council of Teachers of Mathematics.

Standards and Policy

American Association for the Advancement of Science. (1993). Benchmarks for science literacy. NY: Oxford University Press.

Clements, D. H., Sarama, J., & DiBiase, A. M. (2002). Preschool and kindergarten mathematics: A national conference. Teaching children mathematics, 8, (9), 510-514.

Marcon, R. A. (1994). Doing the right thing for children: Linking research and policy reform in the District of Columbia Public Schools. Young Children, 50, (1), 8-20.

National Council of Teachers of Mathematics (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: National Council of Teachers of Mathematics.

National Research Council (1996). National science education standards. Washington D. C.: National Academy Press.

St. John, E. P., Ward, J. G., & Laine, S. W. M. (1999). State policy on professional development: Rethinking the linkages to student outcomes. Oak Brook, IL: North Central Regional Educational Laboratory.

APPENDIX B: CONSULTANTS AND SPECIAL PRESENTERS TO EARLY CHILDHOOD LEARNING COMMUNITY CONFERENCES

Dr. Martha Bronson—Boston College

Dr. Bronson has major responsibility for developing assessment measures for classroom use on the NSF grant, Culturally Meaningful Adventure Stories at Boston College. She is presently coordinator of the early childhood masters and undergraduate programs at Boston College, and is serving as one of the research editors of Young Children, a journal published by NAEYC. Dr. Bronson has extensive experience in the development of assessment tools for young children, and has created and supervised the use of assessment instruments for numerous federal, state and local grants. She has been both a director and a teacher of preschool-kindergarten programs. Dr. Bronson received her Ed.D in Human Development from the Harvard School of Education.

Dr. Edward Chittenden—Educational Testing Service

Dr. Chittenden is a Principal Investigator of the NSF-funded grant, Primary Science Documentation. His major responsibility is as Principal Research Scientist in the Division of Educational Policy Research at Educational Testing Service in Princeton, and is the Director of the research program; Teaching Learning School Assessment. He has conducted a series of studies, over a 20-year period, which have focused upon assessment and evaluation of children's learning in school. Related studies have examined the connections between assessment and instruction and their implications for professional development of teachers. Dr. Chittenden received his Ph.D in Developmental Psychology from Teachers College, Columbia University.

Dr. Douglas Clements—State University of New York, Buffalo

Dr. Clements is the Principal Investigator of the NSF funded project—Building Blocks: Foundations for Mathematical Thinking. He has conducted research and published widely in the areas of learning and teaching of geometry, computer applications in mathematics education, the early development of mathematical ideas, and the effects of social interactions on learning. In addition, Dr. Clements has previous experience as a kindergarten and a preschool teacher. Dr. Clements is Professor of Mathematics and Computer Education at the State University of New York at Buffalo.

Dr Clements contributed to a K-5 mathematics curriculum, Investigations in Number, Data, and Space. In that context, he has co-developed with colleague Dr. Julie Sarama, constructivist-oriented software. In a previous NSF research project, he conducted research on the teaching and learning of geometry with and without computers.

Dr. Clements organized a National Conference on Early Mathematics Standards that took place in the spring of 2000. Funded by the National Science Foundation, the goals of the

conference were to (1) initiate communication among relevant educational leaders and agencies, (2) introduce the latest research findings concerning early mathematical thinking and education, (3) present mathematicians' perspectives on the content and structure of the various mathematical domains, and synthesize these resources to facilitate the creation of standards and curriculum consistent and inclusive, and therefore are both developmentally appropriate and challenging for young children. Dr. Clements received his Ph.D in Elementary Education from State University of New York, Buffalo.

Dr. Janice Earle—National Science Foundation

Dr. Earle is a National Science Foundation Program Officer in the Presidential Awards for Excellence in Mathematics and Science Teaching Program and Assessment of Student Learning (Including TIMSS-R). Prior to coming to the National Science Foundation in 1991, Dr. Earle held positions as Director of the Center on Educational Equity for the National Association of State Boards of Education, Special Projects Coordinator for the National Foundation for the Improvement of Education of the National Education Association, Administrator of Secondary Programs for the Maryland State Department of Education, and teaching positions at the middle and high school level. Dr. Earle earned her Ph.D in Education Policy, Planning, and Administration at the University of Maryland.

Yolanda S. George—American Association for the Advancement of Science

Yolanda S. George is Deputy Director and Program Director for the Directorate for Education and Human Resources, American Association for the Advancement of Science (AAAS). Her responsibilities include conceptualizing, developing, implementing, and planning multi-year projects related to increasing the participation of minorities, women, and disabled persons in science and engineering. She directs or co-directs a number of initiatives including Science Linkages in the Community, the AAAS Black Church Project, Project MOSAIC (a science museum equity project), and Science Education Reform for All (a joint science policy project with the Council of Chief State School Officers). She has served as Director of Development for the Association of Science-Technology Centers and director of a pre-college, university retention, and pre-graduate school program at the University of California, Berkeley.

Ms. George serves as a consultant to numerous federal and state agencies, foundations and corporations, and colleges and universities including the National Science Foundation, the U.S. Department. of Education, Carnegie Corporation of NY, the New Jersey State Department. of Education, and the Louisiana State Department. of Education. She serves on several advisory boards including both non-profit foundations and public service organizations She also has done equity reviews for classroom materials for ACT, ETS, and New Standards.

Dr. Herb Ginsburg—Teachers College, Columbia University

Dr. Ginsburg is the Principal Investigator of the NSF funded project—Big Math for Little Kids. He is currently the Jacob H. Schiff Foundation Professor of Psychology and Education, Teachers College, Columbia University. He has conducted extensive psychological research on the development of children's mathematical thinking in the U.S. and in African and Asian cultures. He has worked on the creation of mathematics assessment methods ranging from standardized tests to clinical interviewing. He has developed videotape workshops for educators on children's mathematical thinking, and has contributed to the development of mathematics textbooks and teacher assessment methods at the primary level. Recent publications include: Flexible Interviewing in the Classroom: Learning What children Know About Math published by Allyn Bacon (1998) and Entering the Child's Mind: The Cognitive Clinical Interview in Psychological Research and Practice. Published by Cambridge University Press (1997). Dr. Ginsburg received his Ph.D in Developmental Psychology at the University of North Carolina, Chapel Hill.

Dr. Jacqueline Jones—Educational Testing Service

Dr. Jones is the Principal Investigator of the NSF sponsored grant, Primary Science Documentation. She is presently a Research Scientist in the division of Cognitive and Instructional Science at Educational Testing Service (ETS) in Princeton, NJ. Prior to joining the ETS research staff, Dr. Jones served as a faculty member at the City University of New York. Most recently, Dr. Jones has been engaged in a series of school-based research projects focusing on documentation and assessment of various aspects of teaching and learning. In addition, Dr. Jones has worked on the design of video and CD-ROM professional development material for early childhood educators. In 2001, she was visiting professor to the Harvard School of Education. Dr. Jones received her Ph.D in Communicative Disorders with a specialization in Language and Learning Disabilities from Northwestern University.

Dr. Mary Ann Millsap—Abt Associates Inc.

Dr. Millsap is a Principal Associate and Vice President at Abt Associates Inc., a policy research and evaluation firm located in Cambridge, Massachusetts. Over the last ten years, she has conducted multiple studies for the National Science Foundation. She directed the Program Monitoring of NSF's Statewide Systemic Initiative, the evaluation of NSF's Cross Directorate Early Faculty Career Development (CAREER) program, and co-directed the evaluation of NSF's Instructional Material Development Program. She is currently co-directing an evaluation of NSF'S Dissemination Centers for Instructional Materials.

Dr. Millsap is also a nationally-recognized expert in the evaluation of educational programs for disadvantaged children. She has more than 25 years of experience conducting implementation and impact studies in urban educational reform (e.g.,

Comer's School Development Program, Annenberg Challenge Grants, and Title I Schoolwide Projects). She is currently directing an evaluation of *Taking AIM,* a comprehensive middle grades reform model, as well as an evaluation of the federal Class-Size Reduction Program. Prior to joining Abt Associates, she was a Senior Associate at the National Institute of Education in the U.S. Department of Education. Her articles have appeared in *Educational Evaluation and Policy Analysis, Equity and Choice*, and *The International Encyclopedia of Education, Second Edition.*

Dr. Iris Rotberg—George Washington University

Dr. Rotberg is Research Professor of Education Policy and Co-director, Center for Curriculum, Standards, and Technology at the Graduate School of Education and Human Development, at George Washington University. Prior to that, she was a Program Director at NSF, Senior Social Scientist at RAND, Principal Investigator for the Technology Task Force of the House of Representatives Committee on Science, Space, and Technology, Assistant Director of the National Institute of Education, and Deputy Director of a comprehensive study of compensatory education conducted for Congress by the National Institute of Education. She also held research positions with the Office of Economic Opportunity, the President's Commission on Income Maintenance Programs, the Human Resources Research Office, and Johns Hopkins University, where she conducted research on psycholinguistics and learning.

Dr. Rotberg's research focuses on school reform, science education, testing and assessment, international education, federal policy in financing education, and the development of methods for evaluating educational programs in a public policy setting. She has published numerous research reports, articles, and commentaries, including RAND reports on federal policy options for improving the education of low-income students. These publications have appeared in *Science, Phi Delta Kappan, The Bridge, Harvard Educational Review, Tech-nos, Prospects, The Education Digest, The Washington Post, and Education Week.*

APPENDIX C: EARLY CHILDHOOD LEARNING COMMUNITY FACILITATORS

Mark Jenness, Ed.D is Director of SAMPI, in the Mallinson Institute for Science Education at Western Michigan University. He has been a member of the management teams of several state and local educational systemic change efforts, including the Michigan Statewide Systemic Initiative, the Vermont Statewide Systemic Initiative, Midland Michigan Local Systemic Change Project, and the Renewing Mathematics Teaching through Curriculum project. He is the Principal Investigator of the Detroit Public Schools Annenberg Challenge Grant External Evaluation. He has been involved in various materials development projects and coordinated a national field test of environmental education curriculum materials. Dr. Jenness has been a consultant and advisor on numerous state and national curriculum, instruction, and science and mathematics education projects. Dr. Jenness earned his Ed.D in Educational Leadership at WMU. He served as Principal Investigator for the Learning Community.

Deanna Draze, Ph.D is a Sr. Research Associate at SAMPI, Mallinson Institute for Science Education at Western Michigan University. Her role at SAMPI involves providing technical assistance and evaluation support for the Michigan Mathematics and Science Center Network, as well as several other mathematics, literacy, and technology projects receiving NSF, Michigan Department of Education, or U.S. Department of Education. Funding. She also teaches graduate courses in educational research and measurement in the College of Education at WMU. Dr. Draze has 20 years of K-8 teaching experience. In addition, she worked as a therapist for the Michigan Dyslexia Institute giving both mathematics and language support to dyslexic students. Dr. Draze earned her Ph.D in Educational Evaluation, Measurement, and Research at WMU. She served as Project Director for the Learning Community.

Robert Laing, Ph.D is a Professor of Mathematics in the Department of Mathematics and Statistics at Western Michigan University. He has served as Co-Director of the Michigan Mathematics Inservice Project funded by the Dwight D. Eisenhower Higher Education Grant Program since 1990 and Co-director of a Michigan Department of Education EESA Higher Education Competitive Grant,The Michigan Middle School Mathematics Resource Teacher Project. He has conducted on-site investigations of several NSF-funded projects: *Seeing and Thinking Mathematically*-Education Development Center; *Investigations in Number, Data, and Space*-Technical Education Research Center; *Mathematics in Context*- National Center for Research in Mathematical Sciences Education; *Everyday Mathematics*-University of Chicago School Mathematics Project; *Math Trailblazers*-University of Illinois; *Math Thematics (STEM Project)* - University of Montana; *Mathematics Through Applications Project*-Institute for Research on Learning; and *Interactive Mathematics Project*-San Francisco State University. Dr. Laing has written numerous journal articles and book chapters in mathematics education and is an active member of state and national mathematics education organizations. Dr Laing earned his Ph.D in mathematics education from Ohio State University. He served as Co-Principal Investigator for the Learning Community.

APPENDIX D: AGENDAS FROM EARLY CHILDHOOD LEARNING COMMUNITY CONFERENCES

Conference #1: Equity Issues in the Development of Instructional Materials

May 1999 Washington D.C. — George Washington University Inn

Conference Objectives:

1. To build a learning community among four projects developing instructional and assessment materials in early childhood mathematics and science
2. To share project descriptions, progress, and barriers
3. To discuss equity issues in the materials development process
4. To develop a set of common outcomes across projects
5. To discuss methods of evaluating the instructional materials development process

Friday, May 8,

10:00 A.M. Opening Remarks and Introductions
- Deanna Draze-SAMPI

Objectives of the Learning Community and Rationale for Cluster Evaluation
- Mark Jenness-SAMPI

10:30 A.M. Project Descriptions
- Building Blocks—Foundations for Mathematical Thinking
- Culturally Meaningful Adventure Stories
- Big Math for Little Kids
- Primary Science Documentation

12:00 Noon Lunch and Informal Networking. Catered on site by Zuki Moon

1:00 P.M. Presentation by Dr. Yolanda George—AAAS

1:30 P.M. Group Dialogue on equity issues in the development of materials. Topics for discussion included:
- Use of materials in diverse cultural settings
- Urban v. rural contexts
- Child development issues
- Infusion of multiculturalism
- Learning styles/learning differences
- Family involvement
- Professional development needs

3:15 P.M. Project Evaluators met with Mark Jenness and Deanna Draze to discuss project-level evaluation plans.

3:15 P.M Principal Investigators met with Robert Laing and Yolanda George to discuss barriers in project implementation (with a focus on equity issues)

4:00 P.M. Networking time for Principal Investigators

5:30 P.M. Dinner and Informal Networking

6:30 P.M. "Seeing the Invisible: An Exploration of the Equity Toolkit"
Participants had opportunity to try out activities in the toolkit and discuss how this resource may be used in the context of their own materials development projects, professional development, evaluation, and family involvement.

8:00 P.M. Adjourn for evening

Saturday, May 8

8:00 A.M. Continental Breakfast and Informal Networking

9:00 A.M Further explanation of Cluster Evaluation—Mark Jenness.

- Common program elements across projects in the ECLC
- Development of consensus around common intended outcomes
- Distinction between impact and assessing process
- How to collect common data across projects
- Key components of materials development leading to common outcomes

11:15-12:30 Next Steps in the Early Childhood Learning Community

12:30 P.M. Lunch and Informal Networking on site—catered by Zuki Moon

Conference #2: Assessment of Children in Early Education Programs

December 1999 Washington D.C. — *American Association for the Advancement of Science*

Conference Objectives:

1. To build a learning community among four projects developing instructional and assessment materials in early childhood mathematics and science
2. To share project descriptions, progress, and barriers
3. To discuss child assessment issues in the materials development process
4. To develop a set of common outcomes across projects
5. To discuss methods of evaluating the instructional materials development process

Friday, December 3

10:00 A.M. Opening Remarks and Introductions

- Deanna Draze-SAMPI
  Remarks from Dr. George Bright—Program Officer, NSF

10:30 A.M. Presentation and Dialogue—Dr. Janice Earle, NSF
- NSF's Current Direction in Assessment

12:00 Noon Lunch and Informal Networking. Catered on site.

1:00 P.M. Presentation and Dialogue—
- Dr. Herbert Ginsburg, Teachers College, Columbia University—Clinical Interviewing of Children

3:00 P.M. Presentations and Dialogue—
- Dr. Martha Bronson, Boston College—Assessment of Self-regulated Learning
- Dr. Jacqueline Jones, ETS and Dr. Edward Chittenden—Basic Principles of Early Childhood Assessment.

5:00 P.M. Collaborations (dinner on own). In the spring, after-conference surveys indicated participants preferred to have dinner on their own and also to have opportunity for extended conversation with other projects. The evening was left open for this purpose.

Saturday, December 4

8:00 Continental Breakfast and Informal Networking

8:30 A.M Cluster Evaluation—Mark Jenness. Group dialogue about:
- Common program elements across projects in the ECLC
- Development of quality indicators
- Discussion regarding collecting common data across projects
- Discussion regarding case studies as a method of evaluation

11:00 P.M. Summary and dialogue about "Next Steps."

12:30 P.M. Lunch and Informal Networking on site—catered

Conference #3: Policy Impacts on Early Education Programs

December 2000 Washington D.C. — *American Association for the Advancement of Science*

Friday, December 1

10:00 A.M. Opening Remarks and Introductions

10:30 A.M. Policy Impacts on Early Childhood Education. Presentation by Dr. Iris Rotberg, Professor of Educational Policy at George Washington University. "Issues in Standardized Testing."

12:00 A.M. Catered lunch and networking

1:00 P.M. Presentation by Dr. Douglas Clements, Professor of Mathematics and Computer Education, State University of New York at Buffalo. "Summary of Conference on Early Mathematics Standards". The final report and recommendations are intended to be a set of guidelines that will enable standards writing groups to create consistent and complementary standards that are based on current understanding of research, practice, and policy in early childhood education.

3:00 P.M. Presentation by Dr. Mary Ann Millsap, Abt Associates. "Summary of the Evaluation of Instructional Materials Development Projects Funded by NSF." This study identified issues and problems related to the development and dissemination of mathematics and science materials.

4:30 P.M. Adjourn.

Saturday, December 2

8:00 A.M. Continental breakfast

8:30 A.M. Project updates.
Brief synopses of progress and issues encountered in the materials development process during the past year.

9:45 A.M. Round-table discussion and participant reactions. Preliminary Observations by SAMPI of the Materials Development Process in Early Childhood.

10:15 A.M. "Telling the Story".
A dialogue regarding the framework for describing the early childhood instructional material development process. Critical issues that developers and funders need to consider were discussed

12:00 Catered lunch and networking

1:00 P.M. Adjourn