Mathematics for All Project

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Activities

The Mathematics for All Project was a collaborative effort between Bank Street College of Education and the Education Development Center to develop a case-based professional development program for teachers of grades K through 5. The Math for All program was developed to better prepare teachers for supporting individual students, including students with disabilities, within a standards-based mathematics curriculum. The target audience for the professional development is general and special education teachers in grades K through 5.

To accomplish the overall goal, the project pursued four major objectives:

1. We developed a library of multimedia cases that portray standards-based mathematics lessons in eleven different elementary classrooms where students with disabilities are included. We also crafted learning experiences that embed the multimedia case materials to support teacher educators and staff developers in their efforts to use the multimedia case resources with pre-service and in-service teachers.

2. We implemented and pilot-tested the professional development materials in several pre-service and in-service teacher education courses at Bank Street College and elsewhere and revised them based on the results of the pilot tests.

3. We field-tested the professional development materials in a range of different settings to document their impact on teachers' knowledge, skill, and classroom practices.

4. We broadly disseminated the case materials and learning experiences to a national audience of teacher educators through workshops and presentations and made arrangements to publish them with a commercial publisher. The materials will be published by Corwin press in 2009.

Below we describe in more detail the accomplishments for each objective.

1. Development of Professional Development Materials

Case Development

Utilizing the case development process developed during the first year of the project and described in detail below, we have developed a total of eleven cases of mathematics lessons. The materials we have assembled for each case include video of one entire mathematics lesson, recorded with multiple cameras that document the experience of three or more carefully selected focal students; video-taped interviews with the teachers conducted prior to and after the lesson; transcripts of the video tapes; still pictures of the classroom; as well as resources related to the lesson, including lesson plans, curriculum guides, handouts, and samples of student work.

Table 1 and 2 below describe the key features of these lessons. As shown in these Tables, the classrooms we videotaped cover grades K through 5. Our case collection includes six lessons

from the K-2 grade span, and five lessons from the 3-5 grade span[1]. Within each of these two grade spans, there is one lesson for each of the five content standards identified by the National Council of Teachers of Mathematics (NCTM, 2000; these include number and operations, geometry, measurement, data analysis and probability, algebra). Each lesson also addresses multiple NCTM process standards (problem solving, representation, communication, reasoning and proof, and connections). The lessons we documented use either the Investigations or the Everyday Math curriculum. The case materials for each lesson highlight the learning experiences of 3-6 focal students. Focal students, carefully selected in collaboration with the teachers, illustrate the range of strengths and weaknesses that students bring to mathematics in each classroom. They include students with learning disabilities (including difficulties with speech and language, attention, processing, visual-spatial organization, and memory), emotional and behavioral disabilities, developmental disabilities (autism and Asperger's syndrome), and students who are not diagnosed with a disability. Several of the focal students are English Language Learners.

Table 1: Grade K-2 Lessons

Grades K-2	**2-d and 3-d Shapes**	**Adding and Subtracting 2**	**Measuring Length**	**Guess my Rule**	**Renaming Numbers**	**Building Buildings**
Curriculum	Investigations	Stern Structural Arithmetic	Investigations	Investigations	Everyday Math	Investigations
NCTM Standards						
Content	Geometry	Number & Operations	Measurement	Data Analysis	Number & Operations	Pre-algebra
Process	Problem Solving	Problem Solving	Problem Solving	Problem Solving	Problem Solving	Connections
	Representation	Reasoning & Proof	Reasoning & Proof	Reasoning & Proof	Representation	Representation
	Communication	Communication	Communication	Communication	Communication	Communication
		Representation	Representation		Reasoning & Proof	Reasoning and Proof
		Connections			Connections	
Grade Level	K	1 and 2	1 and 2	1	1	2
Teacher	1 General Education	1 Special Education	1 General Education	1 General Educaiton	1 General Education, 1 Special Education	1 General Education
Focal Students						
Ability/Disability	Spatial Disability	Emotional Disability, Visual Spatial Disability	English Language Learner, Language Processing Issues	Language & Speech	Global Learning Disability	Grapho-motor, fine motor, decoding in reading
	Bilingual	Attention Deficit Disorder, Auditory Processing Delay	English Language Learner, Language Processing Issues, Memory Issues, Emotional Issues	Asperger Syndrome	Speech & Language Disability, Repeats 1st Grade	Attention, focus
	High Functioning		High Functioning, Rushes through Assignments	High Functioning, Low Confidence	Speech & Language Disability; Low Confidence	Language, (bi-lingual), trouble with concepts and generalizations
					Other Health Impairments	
					Speech & Language Disability	
					High Functioning; Quiet	

[1] We videotaped an additional lower grades classroom to meet our need for a lesson on pre-algebra.
[2] Levine, M. (2002). *A mind at a time*. New York: Simon & Schuster.

[3] This component of the learning experience has been adapted from materials developed by Amy Brodesky and

Table 2: Grade 3-5 Lessons

Grade 3-5	Factors of 100	Multiplication Cluster Problems	Organizing and Presenting Data	Arranging Chairs	Lines of Symmetry
Curriculum	Investigations	Investigations	Investigations	Investigations	Everyday Math
NCTM Standards					
Content	Number & Operations	Number & Operations	Data Analysis	Pre-Algebra	Geometry
Process	Problem Solving	Problem Solving	Reasoning and Proof	Communication	Communication
	Representation	Communication	Representation	Reasoning and Proof	Reasoning and Proof
	Communication		Communication	Problem Solving	Problem Solving
				Represenation	Represenation
Grade Level	3	5	4	3	3
Teacher	Rebecca (Special Education), Natalie (General Education)	Vilma (General Education, Math Leader)	Cristian (Bilingual Education)	Cindy (General Education)	Danita (General Education), Maria (Special Education)
Focal Students					
Ability/Disability	Luis Carlos: Language Delay Learning Disability	Michael: Autism	Bappy: Bilingual, High Functioning	Harpreet: English Language Learner, Attention Deficits, Speech Issues, Socially Isolated	Michael: Learning Disability; Difficulties with Reading and Writing
	Munira: Learning Disability	Paola: Speech & Language	Priscilla: Bilingual, Expressive Language Difficulties	David: Language Processing, Concret Thinker	Elijah: Difficulty with Spatial Organization and following Directions
	David: Learning Disability/ ADHD	Giovanni: Emotional Disability	Ariel: Bilingual, Expressive Language Difficulties, Easily Distractilbe	Jashendeep: Needs to Talk her Thoughts out Loud; Gets Confused by Too Many Details; Repeated a Grade	Shamira: Receptive Language Issues
					Lorayna: Average student

The production of the case materials was carried out in small, multidisciplinary development teams. Each team included four members who brought expertise in mathematics education, special education and inclusion, and video production.

The development of individual cases began with the selection of a classroom for videotaping. To identify potential classrooms we drew on the large network of public and private classrooms that Bank Street College and EDC were working in, and sought recommendations from our colleagues and advisors. We used multiple criteria for selecting classrooms. We looked for classrooms that used a standards-based mathematics curriculum and were known to achieve some degree of success in including students with disabilities. In aiming for exemplary classrooms, our primary goal was not to model practice for teachers to replicate. Rather, we have found that even in classrooms that are considered exemplary for their inclusion practices, teachers struggle to meet the needs of the broad range of students in their classrooms. Other considerations that entered into the selection of classrooms included the type of curriculum used, the kinds of disabilities that students in the classroom had, the grade level of the class, the inclusion model that was being used, the geographic location of the school, and the demographic background of teachers and students. Across the cases, we were aiming for diversity in all of these variables.

Potential classrooms were visited by at least two members of a case development team. During these visits, the team members observed one or more mathematics lesson and interviewed the

teachers to verify that the classroom met our criteria and that the teachers and students were willing to be video taped.

Once a classroom was selected, the case development team met with the teacher or teachers to begin planning for the lesson to be videotaped. The planning meeting included discussions of the content of the lesson and the needs and strengths of individual students. Teachers also received letters and informed consent forms for parents that they distributed to students and helped us collect once signed by their parents. In addition, the case development team conducted further observations of mathematics lessons to better get to know the students and the flow of events within the classroom.

One or a few days prior to a planned video shoot, the case development team conducted a pre-production visit to the classroom to plan for camera placements and sound recording, as well as to collect background materials (such as samples of student work and still images of classroom displays) and consent forms. As part of this visit, the team met with the teacher(s) to review the plan for the lesson, to finalize the selection of two or three students who the cameras would focus on, and to review the logistics of the video taping procedure.

The video shoots were typically completed in one day, and consisted of three parts. First, we video taped a planning discussion with the teacher during which he or she reviewed the plans for the lesson, described the range of learners in his or her classroom, and discussed the strengths and weaknesses of the focal students. Next, we videotaped the math lesson. The lesson was recorded using multiple cameras, each of which focused on a different focal student in order to capture the lesson through the lens of individual children. An additional camera followed the teacher throughout the lesson. Following the lesson, we conducted and video taped a debriefing conversation with the teacher during which he or she reviewed the lesson and reflected together with the case development team on students' work. After the videotaping we took still images and collected materials relating to the lesson (e.g., information written on the board, handouts, student work). For most cases, we videotaped a second follow-up interview with the teacher after he or she had had an opportunity to review the videotape.

Following video production the footage was edited mainly for production quality in order to preserve the real time unfolding of events during the lesson. All dialogue was transcribed, and added as captions to the video. The video files for each case were saved as QuickTime files on DVDs. The files are organized in three parts (planning, lesson, and debriefing). The lesson is indexed for key events (e.g., mini lesson, small group work, reporting back to the large group). Materials relating to the lesson (e.g., handouts, samples of student work) were scanned and included on the DVDs as image files and/or text documents. In addition, the case development team developed context materials, including descriptions of the setting (the school and the classroom), the mathematics of the lesson, background information about focal students, the teacher's strategies for addressing all learners, the development of mathematical thinking within the content area featured in the lesson, and what teachers need to know about teaching the specific mathematics content of the lesson to diverse learners.

Development of Learning Experiences

Learning experiences are organized around specific learning goals for teachers and consist of a sequence of facilitated learning activities that embed segments of the case videos and other case materials. We developed several 1-2 hours learning experiences for pre-service teacher education courses, as well as two 50-hour workshop series for in-service professional development. Below we describe these learning experiences in more detail.

The learning experiences were developed by the case development teams. The development process typically started with a desired purpose or learning goal such as helping teachers develop skill in carefully observing students at work or in analyzing mathematical tasks. The case development team reviewed the video footage for a given case and then selected one or more five- to ten-minute segments of the video materials that supported the desired learning goal. The team also developed introductory activities (e.g., hands-on exploration of tasks that are shown in the video), and follow-up activities (e.g., questions for discussion), produced context materials (e.g., descriptions of the mathematics of the lesson), and assembled background information (e.g., the lesson plan and articles about teaching and learning specific mathematics concepts or about teaching students with a specific disability).

a. Learning Experiences for Pre-Service Courses

We have developed the following case-based learning experiences and piloted tested them in a range of different pre-service courses.

Observe and Discuss. The primary learning goal of this learning experience is for participants to learn how to carefully observe individual children and to take descriptive notes based on their observations. The course facilitator provides background information about the classroom and the mathematics of the lesson. Course participants view one or a few short (3-5 minutes) segments of the video materials showing an individual child in different situations during the lesson. Participants share their initial impressions in small groups, and then view the segment again and take descriptive notes. Subsequently, they share their notes, discuss observation and note-taking techniques, and reflect on how what they noticed differed between the first and second viewing.

Task Analysis. This learning experience has multiple learning goals. It is designed to help participants develop skill in analyzing the demands of specific mathematical tasks and how these demands interact with the strengths and weaknesses of individual learners. It is also designed to contribute to participants' understanding of alternative materials, tools, and instructional strategies for a specific mathematical task and their skills in devising modifications for a given task to better support individual children. The course facilitator provides background information about the classroom and the mathematics of the lesson. As part of this introduction, participants view a video segment of the teacher introducing a specific task to the children in his or her class. Course participants then explore the task portrayed in a given lesson themselves hands on, and take notes about what a learner needs to be able to do in order to successfully complete the task. Participants are then introduced to Mel Levine's (2002)[2] framework which identifies eight different neuro-developmental functions that come to play in any given learning

[2] Levine, M. (2002). *A mind at a time*. New York: Simon & Schuster.

task, including conceptual, language, visual-spatial, organizational, memory, attentional, psycho-social and motor functions. Participants are asked to use the neuro-developmental framework for the analysis of one or more video segments from the lesson. Participants view a video segment of one or more individual children engaged in the task and use the framework to analyze how each student handles the various dimensions of the task.[3] Based on these analyses, participants discuss which aspects of the task helped each child to be successful and which aspects made them less successful, and discuss instructional strategies that could help to more effectively support the individual children observed.

Observing Group Work. In this learning experience, participants learn to carefully observe an individual student working with a partner or a small group of students. Typically, the facilitator introduces the case, providing background information about the classroom and the mathematics of the lesson. The participants then watch a video clip of the teacher introducing a specific mathematical task to his or her students. Before they watch a video clip of a focal student working with a partner or small group of students, participants have the opportunity to explore the task hands on. Participants are asked to carefully observe the small group work and discuss questions, such as "How does or doesn't the group work support the focal students' learning" or "How does the teacher facilitate group work?"

Understanding Instructional Strategies and Adaptations. This learning experience is designed to help participants understand and reflect on the kinds of instructional strategies a teacher might utilize to support learners with diverse needs and strengths, including students with disabilities. In this learning experience, participants review the curriculum guide for a specific lesson and the facilitator walks the participants through the mathematical tasks of the lesson. Participants are then asked to make predictions about the kinds of instructional strategies and adaptations they would introduce in order to support the needs of diverse learners, including students with specific learning issues (e.g., students with language processing issues, students with attention deficits). Subsequently, they are introduced to a handout with a list of instructional strategies and adaptations summarized from the literature, and are asked to identify examples of these strategies in video clips of a teacher teaching the lesson to students with the identified needs. The learning experience concludes with a discussion of how the teacher adapted the lesson, the kinds of instructional strategies he or she used to create an inclusive learning environment, and in what other ways the lesson could be adapted.

In one variation of this learning experience, we had participants use the editing features of QuickTime Pro to isolate video clips within larger video segments, and use the clips as evidence or illustrations of specific instructional strategies they are analyzing. Participants imported their clips into PowerPoint slides to create a multimedia report that included their notes and the video segments that illustrated their response.

Lesson Analysis. This learning experience was designed as a homework assignment to provide opportunities for extended viewing and analysis of the video footage. Course participants are asked to view the video library of a case, including the entire lesson and the planning and debriefing conversations with the teacher (approximately 2-3 hours of video).

[3] This component of the learning experience has been adapted from materials developed by Amy Brodesky and Fred Klein as part of the NSF-funded *Addressing Accessibility* Project.

Course participants are asked to analyze the lesson in writing, addressing the following questions and tasks: What is the math that is being taught? What are the demands of the math activities that students are working on? Select one of the three learners featured in the lesson. What are his or her needs and strengths? How does the teacher create an inclusive learning environment for this student? How did the lesson go? Discuss your reflections. Course participants share their reflections in class and revisit the case as a shared reference point in subsequent discussions in the course.

b. Math for All In-Service Professional Development Program

The purpose of the Math for All professional development program is to enhance the preparation of grade K-5 teachers to help all students including those with disabilities achieve standards-based learning outcomes in mathematics. The Math for All program consists of video-case based curriculum materials and learning activities that form the core of two workshop series for teachers who teach students in grades K-5. One workshop series focuses on grades K-2 and the other on grades 3-5. Each series consist of five day-long sessions and is intended to be implemented over time during the school-year, to make it possible for participants to complete assignments in their classrooms between workshop sessions. Each workshop series provides for 30 hours of class time, plus 10 hours devoted to workshop-related assignments that participants carry out in their classrooms, and 10 hours of follow-up meetings, for a total of 50 hours of professional development during the course of one school year. The workshop series have been designed for teams of general and special education teachers who serve the same students at their schools. Where applicable, these teams can also include paraprofessionals or instructional aides, math coaches, and instructional support specialist who work with the teachers.

Workshop topics focus on planning mathematics lessons that reach all learners, and supporting language use, memory, psychosocial functions, and higher order thinking. Each workshop session also focuses on a specific mathematics content area; these include number and operations, data analysis and probability, measurement, geometry, and algebra (see Appendix 1 for descriptions of the grade K-2 and 3-5 workshop series).

Each workshop session is organized around one particular case lesson. In each workshop session, learning activities are designed to deeply immerse participants in the mathematical activity of the case lesson, in analyzing the learning demands of this activity using a neuro-developmental framework, in observing a student engaged in the activity to assess the extent to which he or she does or does not meet the demands of the activity, and in analyzing teaching practices and instructional strategies that build on individual students' strengths and address their weaknesses. After in-depth analysis of each case lesson in this fashion, participants then connect what they have learned to their own classrooms. Working with the members of their team, they examine the mathematics of a lesson that they will be teaching in-between course sessions, analyze the demands of the core mathematics activity, discuss the strengths and weaknesses of one or more focal children in relation to that activity, and then plan adaptations for the lesson to support student learning. Workshop assignments require participants to implement their lessons plans, to observe their focal students within that lesson, and to reflect on and revise the adapted lesson. Participants also have reading assignments (they read Mel Levine's book *A Mind at a Time*) to familiarize themselves with a neuro-developmental framework of learning. During

follow-up meetings, participants continue the collaborative lesson planning process, and reflect on adaptations that they have implemented previously.

The instructional format of the workshops incorporates key components of constructivist pedagogy, including deep inquiry into children's thinking and behavior to provide guidance for responding differentially to each learner in the classroom; reflection on classroom events to examine beliefs and practices in relation to alternative approaches to particular situations and in relation to theoretical ideas; and learning in groups where teachers can collaboratively explore ideas, make plans, learn from analyzing what is and is not working, and revise plans.

The Math for All program is designed to directly impact teachers' knowledge, skills and classroom practice. Key learning outcomes for teachers include enhanced knowledge about and skill in the informal assessment of individual students' strengths and needs, and the assessment of the demands of mathematical tasks. The program is also designed to help teachers become more knowledgeable about a variety of instructional strategies and more skilled in matching strategies to individual students' strengths and needs, and to enhance their beliefs about mathematics teaching and learning as well as their mathematical content knowledge. Math for All is designed to have a direct impact on teaching practice through classroom-based assignments that require teachers to observe individual students and to collaboratively plan, implement and reflect on adaptations for specific mathematics lessons. Key outcomes for classroom practices include the ongoing assessment of individual students; the adaptation of mathematics lessons to build on students strengths and weaknesses; the use of instructional strategies, classroom structures, and materials that are responsive to individual students' strengths and needs; the pursuit of standards-based learning outcomes by all students, including those with disabilities; and supportive teacher-student interactions.

The Math for All professional development program has been carefully designed based on a best practices model of professional development (e.g., Committee on Science and Mathematics Teacher Preparation, 2001; Loucks-Horsley, Hewson, Love & Stiles, 1998; Mathematical Sciences Education Board, 2001). Recent research has helped to refine and lend empirical support for this model. Garet et al (2001) have identified six core features of professional development activities that were related to teachers' self-reported increases in knowledge and skills and changes in classroom practice. These include (1) a focus on content including the content students learn and how they learn; (2) opportunities for active learning (e.g., to practice and reflect on what they learn and obtain feedback); (3) coherence with other learning activities (e.g., alignment with standards). Related to these core feature were the following structural features: (4) the duration of the activity (e.g., contact hours, span of time); (5) the form of the activity (e.g., workshop vs. study group); and (6) collective participation of teachers (e.g., from the same school, grade, or subject). Table 1 illustrates how the Math for All professional development program incorporates each of these features.

Table 3: Core Features of the Math for All Professional Development Program

Core Features of Effective Professional Development		Core Features of the Math for All Professional Development Program
Content & Pedagogy	**Focus on Content** Content students learn How students learn	Participants are introduced to a neuro-developmental theory of learning (Levin, 2002) Participants analyze the demands of mathematical tasks and consider the mathematical learning goals, contexts, and connections of various math lessons (5 video case lesson and 5 of their own lessons) Participants learn to use a neuro-developmental framework to assess individual students' strengths and needs and consider how students with different strengths and needs learn Participants learn about and reflect on instructional strategies to support students' language, memory, pyscho-social and higher order thinking functions
	Active Learning Practice Feedback Reflection	Participants analyze and reflect on mathematics lessons and student work presented in the video cases and by their colleagues Participants collaboratively plan, carry out and reflect on adaptations to mathematics lessons Participants use informal assessment of individual students to evaluate the outcomes of adaptations Participants receive feedback on their lesson plans and reflections
	Coherence Aligned with standards Consistent with teacher goals	Content of the professional development is aligned with the standards of the NCTM (2000) upon which many state and local standards are based Content is aligned with mandate to include students with disabilities in high-quality education Professional development encourages collaborative lesson planning
Format & Structure	**Duration** Long time-span Many hours	30 hours of workshops 10 hours of classroom-based assignments 10 hours of follow up meetings Conducted over the course of a school year
	Form of the Activity Embedded in teaching	Video-cases of mathematics lessons Lesson study approach Classroom-based assignments Lesson planning for focal students
	Collective Participation Department or grade level	Participation in grade bands: K-2 and 3-5 General and special education teachers work in teams to plan, carry out, and reflect on mathematics lessons

2. Implementation and Pilot Testing of the Case Materials and Learning Experiences

We have intensively pilot-tested Math for All learning experiences with pre-service and in-service teachers. The purpose of the pilot-tests was to inform the ongoing development of our materials. Pilot tests were designed to address the following key questions:

- How do participants respond to the case materials and learning experiences?
- How effective are the materials in helping participants meet the desired learning goals?
- What contextual factors mediate the implementation and outcomes of the learning experiences?

Over course of the project, we had the opportunity to pilot-test Math for All materials and learning experiences in 46 different graduate courses at Bank Street Colleges and in 14 workshops conducted for school districts, at conference, or in other venues. These pilot tests included 933 pre-service teachers, 210 in-service teachers, 105 teacher educators, and 118 other educators (e.g., math coordinators, math coaches, principals, parents). Appendix 2 provides a detailed overview of the participants and materials included in these pilot tests. The graduate courses in which these pilot-tests took place include mathematics methods courses, special education course and foundational courses on child development, as described below:

Mathematics for Teachers in Diverse and Inclusive Educational Settings (Grades N-6).
This course provides students with an overview of mathematics learning for children from nursery school through grade six. The New York City Department of Education accepts one credit of this course as special education credit. The course is offered every semester with multiple sections.

Diagnosis of Learning Problems and Intervention Techniques for the Mathematics Educator
This course conveys the process of clinical teaching. Through focus on an individual child, students examine the practical and theoretical aspects of learning style, language as a learning tool, perceptual abilities and disabilities, dyscalculia, and specific arithmetic disability. This course is being offered both as part of the pre-service Teacher Education program as well as the in-service Mathematics Leadership program.

Research in Mathematics Education
This course is designed to increase students' understanding of qualitative research. It enables students to increase their understanding of the principles of qualitative research, to read and understand articles reporting research studies, and to develop and implement qualitative research. This course is offered as part of the in-service Mathematics Leadership program.

Developmental Variations
The purpose of this course is to increase participants' awareness and understanding of the educational, social, cultural and developmental implications of disability. A range of specific disabilities is discussed with an emphasis on their impact on typical developmental expectations and educational progress. One of the main objectives of the course is to prepare all teachers to recognize, comprehend, accept and meet the needs of students with disabilities who are in their classrooms.

The Study of Children in Diverse and Inclusive Educational Settings through Observation and Recording
In this course, each student conducts an in-depth study of a child. Students learn to use a variety of observational approaches and recording techniques as basic assessment tools to increase their understanding of and skill in planning for children who are developing normally, as well as children with disabilities and special needs. The New York City

Department of Education and the New York State Division of Teacher Certification accept one credit of this course as teaching special education credit.

Early Language and Literacy in Socio-Cultural Contexts: Supporting Development and Adapting for Disability
This course examines communication, language, and literacy as they emerge in infancy through early childhood (birth-8). Special attention is given to the integrated nature of learning in these early years, encompassing social, physical, emotional, and cognitive growth. Throughout the course students are introduced to communication disorders and other disabilities of the early years that affect language and literacy learning. Students learn about and develop examples of balanced early literacy environments and approaches appropriate for different early childhood settings.

Early Childhood Supervised Fieldwork/Student Teaching/Advisement
Students conduct fieldwork in an appropriate setting with supervision and advisement. Students in advisement participate in weekly small-group conferences with their advisor. These seminars include the exchange and analysis of ongoing professional experiences and provide a forum for integrating theory and practice.

In most instances, pilot testing involved the implementation of one learning experience, typically one- to three-hours long, within a course or workshop session. In a few cases, project staff implemented multiple learning experiences during multiple sessions of the same course (e.g., *Mathematics for Teachers in Diverse and Inclusive Educational Settings (Grades N-6)*, *Diagnosis of Learning Problems and Intervention Techniques for the Mathematics Educato*r; and *The Study of Children in Diverse and Inclusive Educational Settings through Observation and Recording)*.

To document participants' responses to the case materials and learning experiences, project staff conducted course and workshop observations, collected work samples and questionnaires from participants, and in some cases conducted informal interviews with the faculty who used the materials. Based on the feedback collected through the pilot tests, the case materials and learning experiences were continually refined.

3. Field-Testing

During the 2006-2007 school year, the Math for All professional development program was field-tested in four diverse locations. The field-test sites included Region 9 in New York City (Northeast, urban), New Canaan, Connecticut (Northeast, suburban), Bismarck, North Dakota (Midwest, rural), and Arkansas (Southern, rural). Each of the participating schools sent a team consisting of a classroom teacher, and a special education teacher. In some sites, classroom aides, math coaches and instructional support specialists were included in the school-based teams. Teams participated in five daylong workshops over a two-three month period of time. In-between workshops, participants had multiple assignments including the on-going observation of at least one student in their classrooms. Two of the sites participated in the grade K-2 workshop series and the other two in the grade 3-5 workshop series.

The research accompanying the field-test was conducted by our external evaluator, the Center for Technology and School Change (CTSC) from Teachers College, Columbia University. The main goals of the research were to examine if the Math for All professional development program would (1) Increase teachers' awareness of different students' strengths and needs; (2) Increase teachers' ability to observe students; and (3) Increase teachers' knowledge of and ability to create and use instructional strategies to address individual students' strengths and needs.

Research Design
A quasi-experimental design was used to assess the impact of teacher participation in the Math for All professional development workshop series. Pre and post assessments were given to both teachers participating in the professional development (i.e., the treatment group) and a non-random comparison set of teachers (i.e., the control group).

Participants
We were able to collect pre- and post-test data from 88 teachers in the treatment group and 22 teachers in the control group as illustrated in Table 4.

Table 4: Number of Participants and Characteristics of the Field-Test Sites

Site	Treatment	Control	State	Region	SES
1	40	16	Midwest	Rural	Middle Class
2	11	1	Northeast	Urban	Lower Middle
3	19	0	Southeast	Predominantly Rural	Lower Middle
4	18	5	Northeast	Suburban	Upper Middle
Total	**87**	**22**			

Data Sources
We utilized multiple instruments and data sources to collect both qualitative and quantitative data about the impact of the Math for All professional development program:

Questionnaires. Pre- and post- teacher questionnaires were given to both the treatment and control groups in 2006-2007. The purpose of the pre-/post questionnaires was to document participants' backgrounds and prior experiences, workshop expectations, and responses to the workshops. Questionnaire data also documented changes in participants' classroom and lesson planning practices, their awareness about key issues concerning the inclusion of students with disabilities, and the perceived impact of the workshops on their professional practice. Pre-questionnaires were administered to the workshop participants (the treatment group) at each of the four field-test sites during the initial workshop session. The post-questionnaire was administered at the conclusion of the fifth workshop session. The control teachers completed the questionnaires at their own time and received a $50 stipend for their efforts.

Performance-Based Assessments. A performance-based assessment (Thinking About a Student in Your Classroom) was administered to both the treatment and control groups. The performance-based assessment documented changes in participants' understanding of and skill in observing students and matching instructional strategies to students' needs and strengths. For the treatment group, the pre-task was assigned to participants prior to the five-part workshop series

and submitted at the first session. The post-task was completed during the final workshop session. The control group teachers completed the pre- and post performance-based assessments online in conjunction with the pre-/post questionnaires.

The pre-assessment asked teachers to:

1) Think about a student they teach whom they have questions about relating to math, and to describe this child.
2) List some instructional strategies and classroom structures that they might use to support the child they described.

The post-assessment asked the teachers to:

1) Describe the same child again now that they have completed the Math for All Workshops, reflecting their current thinking about this child relating to math.
2) Describe their current thinking about the instructional strategies and classroom structures that they might use to support the child they described.

Workshop Feedback Questionnaires. The workshop feedback questionnaires were designed to assess what participants think they have learned; determine which aspects of the individual workshop sessions participants liked; describe how what they learned will contribute to their classroom and professional practice; and gather suggestions for improving the upcoming workshop sessions.

Classroom Observations and Post-Observation Interviews. The goal of the classroom observations was to gather data about the impact of the Math for All workshop series on participants' professional practice. The external evaluators conducted classroom observations in six Region 9 classrooms. Participating teachers volunteered for observations and researchers visited their classrooms one time to observe for 40-60 minutes. The observations were scheduled for three weeks following the final workshop session. Teachers were interviewed following the classroom observation. Six classrooms were observed, two classrooms of which had two teachers working together (i.e., collaborative classroom team). Of the eight teachers observed; three were interviewed independently, four teachers were interviewed in teams of two, and one teacher was not available to be interviewed due to a scheduling conflict. Researchers observed one math lesson selected by the participants. Demographic data about the class was gathered prior to the observation. Teachers identified their focal student to the researcher prior to the observation. When two researchers were present, each researcher focused their observation on one member of the collaborative classroom team.

Results from the field test are reported in the findings section.

4. Dissemination

Our dissemination efforts have focused on sharing information about the project with mathematics educators and researchers, and on preparing the materials we developed for publication.

Workshops and Presentations
We have conducted 47 workshops and presentations at national conferences and in other venues, including presentations at the annual meeting of the Association for Mathematics Teacher Educators (AMTE), the American Educational Research Association (AERA), the National Council of Supervisors of Mathematics (NCSM), the National Council of Teachers of Mathematics, and the Colorado Council of Teachers of Mathematics (CCTM). A comprehensive list of workshops and presentations conducted during the past year is included in the Education and Outreach Activities section of this report. The purpose of these workshops and presentations has been to share the project's emerging findings and to let others know about the availability of the materials. The workshops have also provided us with opportunities for obtaining formative feedback on the case materials and learning experiences.

Papers
We have produced five written papers that describe the process of developing the Math for All materials and emerging findings. These papers have been published as part of conference proceedings and are also being disseminated through our website.

Website
We have begun to develop a dedicated web site for the Math for All Project. The website, which is still under construction, can be found at http://www.edc.org/CCT/MathforAll/. The website provides background information about the project and detailed descriptions of the case materials that we are developing. We are also planning to provide access to workshop materials through this website. Teacher educators and staff developers will be able to download video clips, facilitation guides and handouts from the website for use in their local settings. The website also allows users to download written reports about the project.

Professional Development Materials
Corwin Press will disseminate our materials in the form of a guidebook for facilitators, which consists of video case materials, related multimedia resources, and print materials that guide facilitators in implementing learning experiences that incorporate the cases and resources. The facilitator guidebook, which is entitled *Math for All: A Resource Kit for Facilitating Cases on Inclusion in Elementary Math Classrooms* consists of two volumes, one focused on Kindergarten through 2nd grade and the other focused on 3rd through 5th grade. Each volume contains guidelines for five workshop sessions that together provide activities for a total of about 50 hours of class time. In addition, Corwin will be publishing two participant booklets as well (one for the grade K-2 workshops and one for the grade 3-5 workshops). The participant booklets include tools used in the workshops and instructions for using them. Sample chapters of the facilitator guidebook and the participant booklet are included in Appendix 3 and 4.

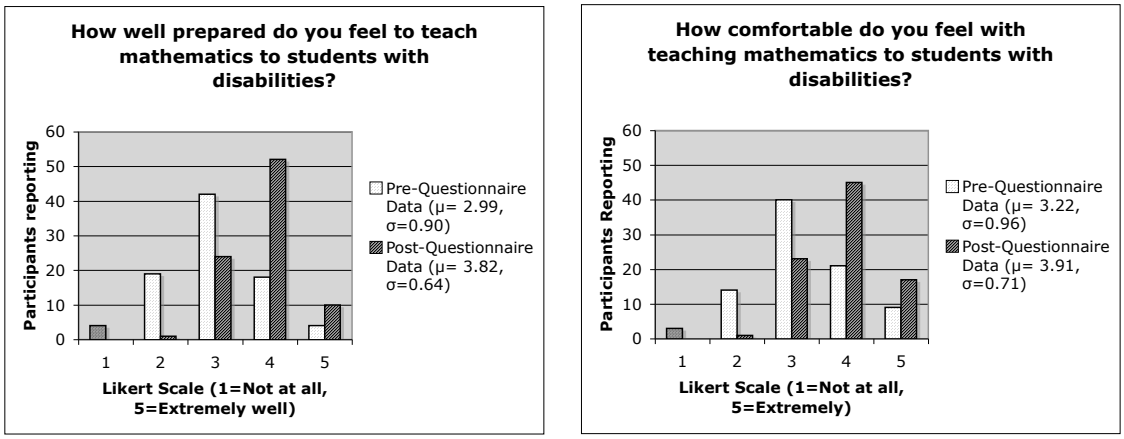
Findings

In this section we summarize the results from our field tests of the grades K-2 and 3-5 in-service workshop series. See Appendix 5 for the full report from our external evaluator.

Pre-/Post Questionnaire Results

A number of impacts were reported by teachers participating in the Math for All workshops. Using a Wilcoxon Signed Ranks Test to analyze participants' pre and post responses to categorical items, seven primary impacts were found to be statistically significant. Of those seven significant items, two are related to the teaching of students with disabilities. The first of these was the significant change in how well prepared teachers feel in teaching mathematics to students with disabilities ($Z=-6.743$, $p<.001$). The second of which was the significant change in how comfortable participating teachers feel in teaching mathematics to students with disabilities ($Z=-5.669$, $p<.001$). In both cases the mean changed significantly in a positive direction, thus with significantly less teachers feeling unprepared or uncomfortable teaching mathematics to students with disabilities. See Figure 1.

Figure 1. *Pre-Post Questionnaire Results: Participant preparedness and comfort in teaching students with disabilities*



The five other primary impacts which showed statistical significance were all related to comfort across the following aspects of planning mathematics lessons: helping teachers observe individual student strengths and weaknesses ($Z=-3.629$, $p<.001$), analyzing the demands of the mathematical task ($Z=-4.014$, $p<.001$), considering the learning goals of the lesson ($Z=-4.456$, $p<.001$), selecting a variety of instructional strategies and materials to support students with diverse strengths and needs ($Z=-4.209$, $p<.001$), and writing lesson plans ($Z=-3.567$, $p<.001$). See Appendix M for more information. The complex intellectual task of synthesizing these five elements to determine what and how to teach mathematics to unique, individual students is the ultimate goal of this grant. The pre-post questionnaire comparison shows a positive correlation between teachers taking the Math for All workshops and gaining in their ratings of ability on each of these tasks.

A strong focus of both the workshops and the teacher reports of changes were in observing student strengths and needs and relating that information to the instructional strategies they selected. Prior to the workshops, participants from the four field-test sites reported the following as the ways in which they most frequently identified student's strengths and needs prior to the Math for All workshops: (1) the use of in class assessments such as teacher made tests or quizzes, worksheets, or homework (53.5%) and (2) the use of observation (51.2%). At the same time, participants reported that they most often select instructional strategies for a particular

mathematics lesson based on: (1) the academic needs of students (68.0%); and (2) the guidelines of the adopted curriculum (40.0%). (See Table 5 for responses by position-type).

Table 5. *Participants' selection of instructional strategies in math prior to the workshop series*

How do you select instructional strategies for a particular mathematics lesson? *This open-ended item yielded the following codes:*	By Position				
	General Education Teacher n=33	Special Education Teacher n=21	Instructional Aide n=13	Math Coach n=8	Overall* n=88
Based on the academic needs of students	72.7%	72.2%	0.0%	100.0%	68.0%
Based on the guidelines of the adopted curriculum	48.5%	50.0%	0.0%	28.6%	40.0%
With assistance from additional teacher resources beyond the adopted curriculum	27.3%	11.1%	0.0%	0.0%	16.0%
With assistance from colleagues	12.1%	5.6%	100.0%	0.0%	16.0%
To promote student engagement	6.1%	5.6%	0.0%	14.3%	6.7%
Based on available classroom resources	6.1%	0.0%	0.0%	14.3%	4.0%
Based on school and/or district expectations	6.1%	0.0%	0.0%	0.0%	2.7%
To support content and process standards	0.0%	5.6%	0.0%	0.0%	2.7%

* Note: Overall descriptive data includes information from positions reported as "other" and "instructional specialist," which are not included in this table.

** Data was obtained from a pre-survey of participating teachers. Please see Appendix K for additional information.

In post-questionnaire responses, 92% reported that the workshops taught them new ideas about how to adapt or modify lessons based on individual students' strengths and needs thus providing participants with a way to respond to student needs. Table 6 (below) lists the specific changes in understanding reported by the teachers.

Table 6. *Participants' reported change in understanding due to the workshop*

	Percentage reporting "Yes"				
	By Position				
Related Item	General Education Teacher n=33	Special Education Teacher n=21	Instructional Aide n=13	Math Coach n=8	Overall* n=88
Have these workshops taught you any new strategies for finding out what a student's strength and weaknesses are?	97.0%	90.5%	100.0%	100.0%	96.6%
Have these workshops taught you anything new about how to adapt or modify lessons based on individual students' strengths and needs?	100.0%	76.2%	92.3%	87.5%	92.0%

* Note: Overall descriptive data includes information from positions reported as "other" and "instructional specialist," which are not included in this table.

** Data was obtained from a post-survey of participating teachers. Please see Appendix L for additional information.

On a five point Likert rating scale (5=A lot and 1=Not at all) participants reported how the workshop series contributed to their professional knowledge in post-questionnaire responses.

The highest ranked option was: The workshop series helped me to enhance my understanding of individual students' needs (see Table 7 below).

Table 7. *Math for All's contribution to participants' professional knowledge*

The workshop series helped me to enhance my understanding of…	1-Not at all	2-Not much	3-Some	4-Quite a bit	5-A lot	**Average**	**Standard Deviation**
…individual students' needs.	0.0%	1.1%	14.9%	47.1%	36.8%	**4.20**	**.73**
…individual students' strengths.	0.0%	2.3%	14.8%	52.3%	30.7%	**4.11**	**.73**
…how to adopt or modify math lessons to help students with diverse strengths and needs meet a given learning goal.	0.0%	3.4%	29.5%	40.9%	26.1%	**3.90**	**.83**
…alternative instructional practices and materials that can be used to pursue a given learning goal.	0.0%	2.3%	37.5%	38.6%	21.6%	**3.80**	**.81**
…the mathematics of specific lessons.	0.0%	4.7%	31.8%	44.7%	18.8%	**3.78**	**.80**

* Data was obtained from a post-survey of participating teachers. Please see Appendix L for additional information.

Prior to participating in the workshop teachers were asked what they would most like to learn from the workshop. Open-ended responses were coded by the researchers to determine their primary expectations. Responding participants reported their top four goals as (1) how to address the strengths and needs of students with disabilities (36.5%); (2) how to address the strengths and needs of all students (28.2%); (3) instructional strategies for teaching generally to a range of learners (36.5%); and (4) instructional strategies for teaching mathematics to a range of learners (27.1%). Reported gains from participants on the post- questionnaires mirrored goals they held for the workshops indicated above on the pre-questionnaires. A total of 96.6 % reported on the post-questionnaire that the workshops had taught them new strategies for finding out what a student's strengths and weaknesses are. Additionally, 92% reported that they felt these workshops had given them new information about how to adapt or modify lessons based on individual students' strengths and needs. Thus participating teachers found a strong congruence between what they hoped to learn and their perceived focus of the actual workshops.

The post-questionnaire asked participants what was the most important lesson they learned from the workshop series. Open-ended responses were coded by researchers and the top four lessons reported by participants were: (1) understanding how students learn, i.e. neuro-developmental Framework (42.0%) (2) understanding the strengths and needs of students (34.1%), (3) learning how to adapt lessons, generally to meet the strengths and needs of students (34.1%), and (4) understanding my role in helping all students succeed, i.e. reach a collective goal (20.5%).

Overall, 95.5% of Math for All participants reported on the post questionnaire that their professional practice would change as a result of the workshops. On the same questionnaire, participants reported that the program had most strongly contributed to their professional skills in the following areas: (1) observing individual students; (2) analyzing the demands of mathematical tasks; and (3) collaborating with colleagues in planning math lessons. See Table 8.

Table 8. *Math for All's contribution to participants' professional skills*

To what extent did the workshop series contribute to your professional skills in the following areas? ***The workshop series contributed to my professional skills in…***	1-Not at all	2-Not much	3-Some	4-Quite a bit	5-A lot	**Average**	**Standard Deviation**
…observing individual students.	0.0%	0.0%	18.2%	46.6%	35.2%	**4.17**	**.72**
…analyzing the demands of mathematical tasks.	0.0%	0.0%	15.9%	54.5%	29.5%	**4.14**	**.66**
…making decisions about how to adapt or modify math lessons to support students with diverse strengths and needs meet the learning goals.	0.0%	00%	31.8%	37.5%	29.5%	**3.98**	**.79**
…collaborating with my colleagues in planning math lessons.	0.0%	3.4%	21.8%	36.8%	37.9%	**4.09**	**.86**

* Data was obtained from a post-survey of participating teachers. Please see Appendix L for additional information.

On a five point Likert rating scale with 5=excellent and 1=poor, the majority of participants at each of the field-test sites gave the Math for All workshop series favorable ratings (Average=4.05, SD=.74), with 91.9% of participants across the field-test sites reported that they would recommend the Math for All workshop series to a colleague.

Table 9. *Participants' top rated workshop components*

The overall goal of the Math for All Workshop series is to help teachers (and staff developers who work with them) be better prepared to teach students with diverse strengths and needs in standards-based math classrooms. For each component of the workshops, please rate how useful you found it for accomplishing the workshop's goals.	1 (Not useful at all)	2	3	4	5 (Extremely Useful)	**Average**	**Standard Deviation**
Using video to observe students	0.0%	0.0%	9.1%	34.1%	56.8%	**4.48**	**.66**
Using video to observe teaching practice	0.0%	0.0%	11.4%	35.2%	53.4%	**4.42**	**.69**
Applying what I have learned in the workshop in my own classroom (e.g., observation of a child)	0.0%	2.3%	20.7%	49.4%	27.6%	**4.36**	**.75**
Hands-on exploration of math activities	1.1%	1.1%	11.4%	37.5%	48.9%	**4.32**	**.81**

* Data was obtained from a post-survey of participating teachers. Please see Appendix L for additional information.

A factor analysis of key questionnaire items identified two constructs (Table 10). Each factor was tested for internal consistency and deemed reliable at an acceptable level of $\propto$>0.80 (Table 11). The first factor captured teachers' comfort level with different aspects of adapting mathematics lessons based individual students' strengths and needs. The second factor captured teachers' perceived efficacy for teaching students with disabilities.

Table 10. *Factor analysis of key questionnaire items*

Scale Item		Factor Loading
Factor 1: Assessing student needs in relation to the demands of the math lessons		
	Comfortable considering the learning goals of the lesson	0.924
	Comfortable thinking about how the math of the lesson connects to the math students have studied in the past and will study in the future	0.867
	Comfortable analyzing the demands of the mathematical task	0.862
	Comfortable thinking about individual student's strengths and needs	0.790
	Comfortable selecting a variety of instructional strategies and materials to support students with diverse strengths and needs	0.689
Factor 2: Preparedness to teach students with disabilities		
	Comfortable teaching students with disabilities	0.919
	Prepared to teach students with disabilities	0.918

Table 11. *Reliability Analysis*

Factor	Number of Items	N	Cronbach's Alpha
Factor 1: Planning Mathematics Lessons	5	102	0.9151*
Factor 2: Teaching Students with Disabilities	2	109	0.8997*
Overall	7	102	0.9020*

*Acceptable at $\alpha > 0.80$.

Levene's Test for Equality of Variances confirmed homogeneity between the control and treatment groups before an independent samples t-test and a one-way analysis of variance was used to compare related pre-post differences in means on the established constructs. Analyses were performed on gain scores in an effort to remove initial differences between the control and treatment groups. We found that teachers in the treatment group were significantly more likely than the control teachers to show an increase in their perceived efficacy for teaching students with disabilities on the post-test (see Tables 12-15 below).

Table 12. *Group Statistics by Factor*

Factor	Group	N	Mean	Standard Deviation	Standard Error Mean
Factor 1: Assessing student needs in relation to the demands of the math lessons	Treatment	78	2.423[a]	4.517	0.511
	Control	20	1.200[a]	4.742	1.060
Factor 2: Preparedness to teach students with disabilities	Treatment	85	1.506[a]	1.556	0.169
	Control	22	0.318[a]	1.492	0.318

[a]Mean can be interpreted as the average difference between pre and post scores (i.e., average gain score)

Table 13. *Independent Samples Test: Significance of Differences between pre-post gain scores of treatment and control teachers*

	Levene's Test for Equality of Variances		t-test for Equality of Means			
Factor	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Factor 1: Assessing student needs in relation to the demands of the math lessons	.090[a]	0.765	1.070	96	0.287	1.223
Factor 2: Preparedness to teach students with disabilities	.239[a]	0.626	3.218	105	0.002**	1.189

* Significant at p<.05 ** Significant at p<.01 *** Significant at p<.001
[a]Assumption of equal variances can be assumed.

Table 14. *One-Way Analysis of Variance (Factor 1): Significance of Differences between pre-post gain scores of treatment and control teachers*

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23.813	1	23.813	1.144	.287
Within Groups	1998.238	96	20.815		
Total	2022.051	97			

* Significant at p<.05 ** Significant at p<.01 *** Significant at p<.001

Table 15. *One-Way Analysis of Variance (Factor 2): Significance of Differences between pre-post gain scores of treatment and control teachers*

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.653	1	24.653	10.353	.002**
Within Groups	250.020	105	2.381		
Total	274.673	106			

* Significant at p<.05 ** Significant at p<.01 *** Significant at p<.001

Performance-Based Assessments

The pre-/post performance based assessments support the findings from the questionnaire data and provide additional evidence, beyond self-reports, of the impact of the Math for All workshops on the treatment group.

The majority of the treatment group showed changes in their pre-/post descriptions of their focal students and the instructional strategies and classroom structures they would use to accommodate the student's needs. Changes in the post performance-based descriptions included the following: (1) use of the neuro-developmental framework to observe and characterize the focal student; (2) inclusion of focal student's strengths and needs; (3) use of a broader range of instructional strategies and classroom structures and (4) alignment of instructional strategies and classroom structures with the strengths and needs of their focal students.

- Treatment and control teachers used similar language to describe their focal students in the pre performance-based assessments. Teachers from both groups selected students who were struggling academically and they specifically described some of the problems these focal students encountered in math. The teachers then described a variety of instructional strategies that they have tried to accommodate the needs of their focal students.

- The post performance-based assessments show evidence that the majority of treatment teachers shifted in the language that they used to describe their focal students. In most instances, the treatment group aligned their instructional strategies and classroom structures with the descriptions of their focal students.

- In the post performance-based assessments, the treatment group used the Mel Levine's neuro-developmental framework to guide both their observation and description of their focal student. They referred to psycho-social, language, memory, attention, and sequential ordering constructs in their descriptions.

- In the post performance-based assessments, the treatment group referred to a broader range of instructional strategies and classroom structures in their descriptions. They also described the variety of ways they modified their lessons to illustrate the instructional strategies and classroom structures they are currently using to support their focal students.

- In the post performance-based assessments, the treatment group referenced many of the instructional strategies that are discussed in the Math for All workshops.

- In some of the post performance-based assessments, treatment teachers included instructional strategies for supporting "higher end" students.

- In the post performance-based assessments, the treatment group teachers changed their description to focus more on their focal student's strengths.

To produce quantifiable information, the performance-based assessments were coded across the aforementioned themes (see Tables 16 – 17). Performance-based assessment items were open-ended and did not precisely match between pre- and post- tests. Different themes were thus established for each instrument. Five primary themes emerged from the pre-assessment (see Table 16), allowing for a total pre-score of 5. Five primary themes emerged from the post-assessment (Table 17), allowing for a total post-score of 5. An analysis of variance between the two groups showed a significant difference between group means on the performance-based post-test ((F=41.370, p<.001; see Tables 18-19).

Table 16. *Performance-based pre-assessment themes across treatment and control groups*

	Percentage of Group Exhibiting Theme	
Theme	Control n=22	Treatment n=58
1. Describes student who is struggling academically	100.0%	98.3%
2. Provides description of problems that the student encounters in math	90.9%	69.0%
3. Describes student's strengths	59.1%	72.4%
4. Lists instructional strategies	100.0%	98.3%
5. Links instructional strategies to identified student's needs	86.4%	89.7%

Table 17. *Performance-based post-assessment themes across treatment and control groups*

Theme	Percentage of Group Exhibiting Theme	
	Control n=22	Treatment n=58
1. Describes student's growth as a math learner	77.3%	87.9%
2. Aligns instructional strategies to students' strengths and needs	86.4%	98.3%
3. Uses Mel Levine's neuro-developmental framework to guide observation	0.0%	81.0%
4. Uses a broad range of instructional strategies and classroom structures	68.2%	91.4%
5. Includes student's strengths in description of focal student	63.6%	93.1%

Table 18. *Mean performance-based assessment scores across groups*

Assessment	Group	N	Mean	Standard Deviation
Pre	Treatment	58	4.3103*	0.7993
Pre	Control	22	4.3636*	0.8477
Post	Treatment	58	4.5172**	0.9030
Post	Control	22	2.9545**	1.1329

* Mean based on five pre-assessment themes
** Mean based on five post-assessment themes

Table 19. *Analysis of performance-based post-assessment scores across groups using a one-way analysis of variance*

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	38.950	1`	38.950	41.370	.000***
Within Groups	73.437	78	0.942		
Total	112.388	79			

* Significant at p<.05 ** Significant at p<.01 *** Significant at p<.001

Classroom Observations

The classroom observations and post-interviews provide evidence beyond participants' self report data (i.e., workshop feedback forms and questionnaires) of the degree of change in participants' knowledge, skill and classroom practice.

The classroom observations and post-interviews demonstrate that workshop participants are observing individual students, modifying math lessons to accommodate the needs of the students, and incorporating a range of instructional strategies into their classroom practice.

- Teachers reported a range of abilities and disabilities in their classes. The most commonly reported disabilities were around ESL including speech and language issues.

- Teachers reported a variety of ways that they were accommodating students with varying abilities and disabilities. The most frequent responses included the use of visual aides.

- Teachers reported that many of the students in the observed classrooms were visual and tactile learners.

- Teachers reported using the *Everyday Math* curriculum when planning their lessons, but tailoring the curriculum to meet the needs of their students.

- All the teachers participating in the post-interview did not work with anyone else when planning the observed lesson. However, further probes revealed that the collaborative team teachers worked together to plan the lessons. One of the teachers also mentioned that she typically worked with the math coach to plan and modify weekly lessons.

- All of the teachers responded that they did not use the accessible learning chart (a handout used in the Math for All workshops to scaffold teachers' lesson planning) to plan the observed lesson. However, the teachers reported that they either, "keep the chart in mind" or "think about the chart" when planning their lessons.

- Three of the five teachers reported that they did not work through the activities themselves before teaching the lesson. These teachers felt that they could predict what their students would do or that they "did the activity in their head."

- All of the teachers anticipated that psycho-social and memory problems might arise for specific students during the observed lesson.

- All of the teachers reported planned modifications for specific students. A number of teachers thought that limiting the number of options or size of numbers in a particular lesson would support their students. For example:

  > "…when their [referring to the students] journals have double digit math, I often white out one of the numbers." (DK)

  > "…we limited each of them [referring to the students] to two colors and only a few shapes." (MS)

  Another teacher described a variety of ways that she modified her lesson to support her students. She organized materials for the lesson in a particular way. She verbally reinforced students as they counted during a group meeting and she asked students to orally explain their thinking as they worked on math activities.

  > I planned to count with the students as they were placing the pennies on the board, or to verbally recount their actions as they work. I also had an organizational strategy in place. For example, I was sure to have them place their nickels and pennies in separate piles before they began. (SS)

  A collaborative team of teachers planned a number of visual modifications for their bilingual class:

  > We planned modifications for two students, Usberto and Enrique. In both of their charts, we put an example of tercios underneath the heading. Their workbooks came with the same chart, but we felt it was better to make the chart much bigger. Also, we used real examples of cutting objects into equal parts. For example, we had a slice of bread and a pizza. (GS)

In another classroom, the teacher made visual modifications and reworked various student partnerships.

> Having the students rip out the page, so that they weren't just working in one math journal, but on a separate sheet. As a visual modification, I modeled with the large pair of dice. I also switched a couple of the regular partnerships. (DK)

- Most of the teachers reported that they grouped students by ability for the observed lesson.

- Teachers reported the following issues that arose during the observed lessons: not enough time for allocated activities; student's lack of understanding of language and vocabulary of the lesson; problems with the materials selected for the activity; partnering versus student working on his own; and psycho-social issues.

- All of the teachers identified things that they would do differently if they taught the lesson again.

- Four of the six teachers felt that the Math for All workshops had an impact on their students in math. For example, during the post-observation interview, one teacher describes how her participation in the workshops is beginning to change her attitude about the significance of math in her classroom curriculum.

> Math has always been one of my weaker areas, but perhaps that's just because it's often neglected in the schools. I often have this guilty feeling if I'm not entirely focused on literacy or doing my best to help students in reading/writing. However, I don't have this same feeling of guilt when it comes to math. This workshop has helped me realize the importance of math and help me make the overall Everyday Math curriculum more meaningful for my students. (SS)

- Five of the six teachers felt that their student learned more in math since they participated in the Math for All workshops. They attributed changes to the following factors: (1) teacher and student learned more in math; (2) students understood concepts better; (3) teachers (were) more focused in their assessment of student learning and; (4) math became a priority in the classroom.

- Two of the six teachers had informal or formal test data to share.

Summary

A quasi-experimental research design was used to determine whether the Math for All professional development program impacted participants' knowledge, skill, and classroom practice. Multiple impacts emerged in the analysis of the pre-post questionnaires, pre-post performance-based assessments, classroom observations and post-observation interviews:

- A factor analysis of the pre-post questionnaire data indicated that the Math for All professional development program was effective in enhancing the preparation and comfort of teachers working with students with a range of abilities and disabilities.

- Post-questionnaire data showed that one significant aspect of the workshop series for the workshop participants was learning how to adapt and modify lessons based on individual students' strengths and needs thus enabling them to be responsive to student needs.

- Post-questionnaire data revealed that the workshop series contributed to workshop participants' professional knowledge, enhancing their understanding of individual students' needs.

- Data showed that the workshops contributed to workshop participants' professional skills. Specifically, participants reported the following about changes in their professional skills: (1) observing individual students; (2) analyzing the demands of mathematical tasks; and (3) collaborating with colleagues in planning math lessons.

- The pre-post performance-based assessments included changes in the descriptions of focal students and provided further evidence of the impact of the Math for All workshops. Changes in post performance-based descriptions included the following: (1) use of the neuro-developmental framework to observe and characterize the focal student; (2) inclusion of the focal student's strengths and needs; (3) use of a broader range of instructional strategies and classroom structures and (4) alignment of instructional strategies and classroom structures with the strengths and needs of their focal students.

- The classroom observations and post-observation interviews demonstrated that the workshop participants were observing individual students; modifying math lessons to accommodate the needs of the students; and incorporating a range of instructional strategies into their classroom practice.

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Educational Outreach Activities

The Math for All team conducted the following workshops and presentations:

Conference Presentations 2003-2004
Dubitsky, B., Marschke-Tobier, K., Melnick, H., Metnetsky, L. & Moeller, B. (2003). *Mathematics for All: Designing multimedia cases to prepare teachers for inclusions the mathematics classroom.* Paper presented at the annual meeting of the Society for Information Technology and Teacher Education (SITE), Albuquerque, NM, March 24-29, 2003.

Moeller, B., Cohen, M., Dubitsky, B., Marschke-Tobier, K., Melnick, H., Metnetsky, L., Brothman, A., & Kantrov, I.,(2004). *Using multimedia case studies to help teachers learn about inclusion in the elementary mathematics classroom.* Paper to be presented at the annual conference of the Society for Information Technology and Teacher Education (SITE), Atlanta, GA, March 2, 2:00 pm.

Melnick, H., Marschke-Tobier, K., Moeller, B., Dubitsky, B., Cohen, M., Brothman, A., Kantrov, I. & Anderson, L. (2004). *Teaching Math in an Inclusion Classroom: What we Can Learn From Case Studies.* Presentation at the EDC/Center for Children and Technology, March 10, 2004.

Moeller, B. (2004). *Using technology to support math and science learning for all.* Invited Keynote, Workshop, and Roundtable presented at the Universal Design Conference: Reaching All Children Through Technology, Westchester Campus of Long Island University, March 19, 2004.

Conference Presentations 2004-2005
Meier, E., Powell, K., Moeller, B. & Dubitsky, B. (2005). *Setting the Stage for Reflective Practice: Multimedia Case Study Development*. Paper presented at the SITE International Conference, Phoenix, AZ March 1-5, 2005.

Moeller, B. & Brothman, A. (2005). *Designing Digital Video Case Resources for Mathematics Teacher Education*. Paper presented at the SITE International Conference, Phoenix, AZ March 1-5, 2005.

Conference Presentations 2005-2006:
Moeller, B. & Dubitsky, B. (2006). *Similarities and Differences in Using Video Case Studies in Pre-Service and In-Service Math Teacher Education*. Paper presented at the annual meeting of the Society for Information Technology in Teacher Education, Orlando, FL, March 20-24, 2006.

Moeller, B., Dubitsky, B., Meier, E., & Kantrov, I. (2006). Designing and Using Video Case Studies for Professional Development on Inclusion in Elementary Mathematics Classrooms. In I. Kantrov (chair), *Use of Videocases in Mathematics Teacher Development: What are we Learning?* Symposium to be conducted at the annual meeting of the American Educational Research Association (AERA), San Francisco, CA, April 7-11, 2006.

Conference Presentations 2006-2007:
Moeller, B. & Cohen, M. (2006). *Using Video Cases to Help Teachers Increase Access to Math for Diverse Learners*. Presentation conducted at the annual conference of the Colorado Council of Teachers of Mathematics, Denver, CO, September 29, 2006.

Moeller, B. & Cohen, M. (2007). *Using Video Cases to Help Teachers Increase Access to Math for Diverse Learners*. Paper presented at the annual meeting of the Association of Mathematics Teacher Educators, Irvine, CA, January 25-27, 2007.

Moeller, B. & Dubitsky, B. (2007). *Math for All: Planning Math Lessons that are Accessible to All Students.* Invited presentation to be conducted at the 2nd annual Thirteen/WNET Celebration of Teaching and Learning, New York, NY, March 23-24, 2007.

Marchese, C., Dubitsky, B., Cunningham, K., Moeller, B., & Metnetsky, L. (2007). *Inclusion in the Math Class: Shared Professional Development between Region 9 in New York City and Bank Street College of Education*. Presentation to be conducted at the annual meeting of the National Council of Supervisors of Mathematics, Atlanta, GA: March 19-21, 2007.

Moeller, B. & Dubitsky, B. (2007). *Using Video Case Studies to Help Teachers Learn About Inclusion in Math*. Paper to be presented at the NCTM Research Pre-Session. Atlanta, GA: March 19-21, 2007.

Moeller, B., Dubitsky, B., & Meier, E. (2007). Math for All: Using Video Case Studies in Learning to Assess the Strengths and Needs of Diverse Learners. Paper to be presented in I. Kantrov (chair), *Using Records of Practice to Focus Mathematics Professional Development on Student Learning: Effective Tools and Strategies*. Symposium conducted at the Annual Meeting of the American Educational Research Association, Chicago, IL, April 2007.

Meier, E. B., Powell, K., Hollands, F., Moeller, B., & Dubitsky, B. (2007). Preparing teachers to teach mathematics in inclusion classrooms: A multi-media case based approach. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL, April 2007.

Conference Presentations 2007-2008:
Meier, E. B., Powell, K. A., Hollands, F. M., Mineo, C. M., Moeller, B., & Dubitsky, B. (2008). *Math For All: An Opportunity to Develop Our Civic Responsibility to Inclusion Students.* Paper presented at the annual meeting of the American Educational Research Association, New York, NY, March 23-28, 2008.

Dubitsky, B., Moeller, B., Cohen, M., Melnick, H., Myer,M., Hanke, T., Sandstrom, B. (2008). *Math for All: Promoting Long-Term Impact of Professional Development on Meeting the Needs of a Wide Range of Learners in K-5 Mathematics*. Presentation conducted at the annual meeting of the National Council of Supervisors of Mathematics, Salt Lake City, UT, April 7, 2008.

Moeller, B., Dubitsky, B. & Meier, E. (2008). Using Video Case Studies in Learning to Assess the Strengths and Needs of Diverse Learners. Paper presented at the NCTM Research Pre-

Session. Salt Lake City, UT, April 9, 2008.

Workshops and Demonstrations 2003-2004:
Moeller, B., Dubitsky, B., Marschke-Tobier, K., Metnetsky, L., Melnick, H. (2003).

Mathematics for All: Using multimedia case studies to teach teachers about inclusion in the mathematics classroom. Demonstration conducted at the Technology Street Fair conducted at Bank Street College, April 28, 2003.

Dubitsky, B., Melnick, H., Metnetsky, L., Marschke-Tobier, K., Brothman, A. & Moeller, B. (2003). *Learning and teaching mathematics in inclusion classrooms*. Faculty Seminar presented at Bank Street College of Education, October 15, 2004, 12-2 pm.

Moeller, B. & Anderson, L. (2004). *Mathematics for All Project: An Overview*. Presented at EDC/Center for Children and Technology, January 14, 2004.

Moeller, B., Dubitsky, B., Marschke-Tobier, K., Metnetsky, L., Melnick, H. (2004). *Using multimedia case studies to help teachers learn about inclusion in elementary mathematics classrooms.* Workshop to be presented at the annual meeting of the Association of Mathematics Teacher Educators, San Diego, CA, January 22, 2004, 1:30 to 4:30 pm.

Dubitsky, B., Melnick, H., Metnetsky, L., Moeller, B., Brothman, A., Cohen, M., Marschke-Tobier, K., Kantrov, I. & Anderson, L. Saturday Math Seminar at Bank Street College of Education, New York, March 6, 2004, 10 am –1 pm.

Dubitsky, B., Moeller, B., Melnick, H., Metnetsky, L., Marschke-Tobier, K. (2004). *Mathematics for all: A multimedia case study approach to professional development in the elementary classroom*. Workshop presented at the annual conference of the National Council of Supervisors of Mathematics, Philadelphia, PA, April 20, 2004, 10:10 to 11:00 am.

Metnetsky, L. & Moeller, B. (2004). *Mathematics for All: Using multimedia case studies to teach teachers about inclusion in the mathematics classroom.* Demonstration conducted at the Technology Street Fair conducted at Bank Street College, April 22, 2004.

Workshops and Demonstrations 2004-2005
Dubitsky, B., Cohen, M., Marschke-Tobier, K. & Brothman, A. (2005). *Math for All: Inclusive Mathematics Curriculum in the Elementary Classroom*. New Perspectives Course, Bank Street College of Education, April 15-16, 2005.

Dubitsky, B.,& Brothman, A. (2005). *Mathematics for all: A multimedia case study approach to professional development in the elementary classroom.* Demonstration conducted at the Bank Street College Share Fair, March 18, 2005.

Dubitsky, B., Melnick, H., Moeller, B. & Brothman, A. (2005). *Math for All: A Multimedia Case Study Approach to Inquiry Into K-6 Inclusion Practice*. Workshop conducted as part of the Saturday Math seminar series. New York: Bank Street College of Education, March 5, 2005.

Moeller, B. & Dubitsky, B. (2005). *Mathematics for All: A multimedia case study approach to inquiry into K-6 inclusion practice*. Workshop presented at the AMTE Annual Conference, Dallas, Texas, January 28-29, 2005.

Moeller, B. & Dubitsky, B. (2005). *Math for ALL: Flexible Multiplication Thinking through Cluster Problems*. Invited workshop for teachers. Bismarck, ND Public Schools, January 10, 2005.

Moeller, B. & Dubitsky, B. (2005). *Math for ALL: Flexible Multiplication Thinking through Cluster Problems*. Invited workshop for parents. Bismarck, ND Public Schools, January 10, 2005.

Moeller, B. & Dubitsky, B. (2004). *Mathematics for All: A multimedia case study approach to professional development in the elementary classroom.* Demonstration conducted at the annual Technology Innovators' Conference, Washington, D.C. November 15-17, 2004.

Moeller, B., Dubitsky, B., & Kantrov, I. (2004). Math for All: Multimedia Studies on Inclusion. Brown Bag, conducted at the Education Development Center, Newton, MA, June 16, 2004.

Workshops 2005-2006:
Math for All: Inclusive Mathematics Curriculum in the Elementary Classroom
New Perspectives Course, Bank Street College of Education, April 15-16, 2005.

Moeller, B. & Dubitsky, B. (2005-2006). *Math for All: Helping All Students to Attain High Quality Learning Outcomes in Math*. Workshop series conducted for the Bismarck Public Schools, September 27, 2005, November 15, 2005, February 1, 2006, March 8, 2006, and April 19, 2006.

Moeller, B. & Dubitsky, B. (2005). *Math for All: Helping All Students to Attain High Quality Learning Outcomes in Math*. Workshop series conducted for Region 9 of the New York City Department of Education, October 25, November 22, November 29, December 7, and December 13, 2005.

Dubitsky, B. & Moeller, B. (2006). *Math for All: Facilitating Case-Based Professional Development on Inclusion in the Elementary Math Classroom*. Workshop series conducted for Math for All facilitators. New York, Bank Street College of Education, January 11-13.

Moeller, B., Dubitsky, B. & Cohen, M. (2006). *Supporting Teacher Educators in the Use of Video Case Studies on Inclusion in Elementary Math Classrooms*. Paper presented at the annual meeting of the Association of Mathematics Teacher Educators (AMTE), Tampa, FL, January 26-28, 2006.

Melnick, H., Marschke-Tobier, K., Metnetsky, L., Moeller, B. & Dubitsky, B. (2006). *Math for All: A Multimedia Case Study Approach to Inquiry Into K-6 Inclusion Practice*. Workshop conducted as part of the Saturday Math seminar series. New York: Bank Street College of Education, March 4, 2006.

Metnetsky, L., Melnick, H., Moeller, B. & Dubitsky, B. (2006). *Learning to use Video Case Studies of Inclusion Classrooms for Professional Development Workshops in Your School District*. Workshop conducted at the annual meeting of the National Council of Supervisors of Mathematics (NCSM), St. Louis, MO, April 24-26, 2006.

Workshops 2006-2007:

Moeller, B. & Cohen, M. (2006). *Math for All: Planning Math Lessons that are Accessible to All Students*. Pre-Session conducted at the annual conference of the Colorado Council of Teachers of Mathematics, Denver, CO, September 28, 2006.

Moeller, B. & Dubitsky, B. (2006-2007). *Math for All: Helping All Students to Attain High Quality Learning Outcomes in Math*. Workshop series conducted for the Bismarck Public Schools, September 21, 2006, October 12, 2006, November 16, 2006, December 7, 2006, and January 11, 2007.

Moeller, B. & Dubitsky, B. (2006-2007). *Math for All: Helping All Students to Attain High Quality Learning Outcomes in Math*. Workshop series conducted for Region 9 of the New York City Department of Education, November 1, 2006, November 28, 2006, December 12, 2006, January 16, 2007, and February 6, 2007.

Moeller, B. & Dubitsky, B. (2006-2007). *Math for All: Helping All Students to Attain High Quality Learning Outcomes in Math*. Workshop series conducted for multiple districts from the state of Arkansas, September 19, 2006, October 24, 2006, November 14, January 9, 2007, and March 1, 2007.

Moeller, B. & Cohen, M. (2006-2007). *Math for All: Helping All Students to Attain High Quality Learning Outcomes in Math*. Workshop series conducted for the New Canaan, CT school district, November 7, 2006, December 13, 2006, January 17, 2006, February 7, 2007, and March 9, 2007.

Melnick, H., Metnetsky, L., Marschke-Tobier, K., Moeller, B. & Dubitsky, B. (2007). *Math for All*. Workshop conducted as part of the Saturday Math series. New York, NY: Bank Street College of Education, February 3, 2007.

Workshops 2007-2008

Melnick, H. & Moeller, B. (2008). *Supporting higher order thinking for diverse learners in the math classroom*. Workshop conducted as part of the Saturday Math series. New York, NY, Bank Street College of Education, March 1, 2008.

Products

Books and One-Time Publications

Moeller, B., Dubitsky, B., Kantrov, I., Cohen, M., Marschke-Tobier, K., Melnick, H., Metnetsky, L., Brothman, A., & Clarke, J. (in press). *Math for All: A Resource Kit for Facilitating Cases on Inclusion in Grade K-2 Math Classrooms*.

Moeller, B., Dubitsky, B., Kantrov, I., Cohen, M., Marschke-Tobier, K., Melnick, H., Metnetsky, L., Brothman, A., & Clarke, J. (in press). *Math for All: A Resource Kit for Facilitating Cases on Inclusion in Grade 3-5 Math Classrooms*.

Moeller, B., Dubitsky, B., Kantrov, I., Cohen, M., Marschke-Tobier, K., Melnick, H., Metnetsky, L., Brothman, A., & Clarke, J. (in press). *Math for All: Participant Guide for Grades K-2*.

Moeller, B., Dubitsky, B., Kantrov, I., Cohen, M., Marschke-Tobier, K., Melnick, H., Metnetsky, L., Brothman, A., & Clarke, J. (in press). *Math for All: Participant Guide for Grades 3-5*.

Other Products

Powell, K., Mineo, C., Hollands, F., Hakim, S. & Horton, D. (2008). *Mathematics for All*: *Year 4 Evaluation Report, September2006-June 2007.* New York: The Center for Technology and School Change, Teachers College, Columbia University. New York: The Center for Technology and School Change, Teachers College, Columbia University.

Meier, E. B., Powell, K. A., Hollands, F. M., Mineo, C. M., Moeller, B., & Dubitsky, B. (2008). *Math For All: An Opportunity to Develop Our Civic Responsibility to Inclusion Students.*

Meier, E. B., Powell, K., Hollands, F., Moeller, B., & Dubitsky, B. (2007). Preparing teachers to teach mathematics in inclusion classrooms: A multi-media case based approach. New York: The Center for Technology and School Change, Teachers College, Columbia University.

Powell, K. (2006). *Mathematics for All*: *Year 3 Evaluation Report, March 2005-March 2006.* New York: The Center for Technology and School Change, Teachers College, Columbia University.

Moeller, B. & Dubitsky, B. (2006). *Similarities and Differences in Using Video Case Studies in Pre-Service and In-Service Math Teacher Education*. Proceedings of the SITE International Conference, Orlando, FL, March 20-24, 2006.

Powell, K. (2005). *Mathematics for All*: *Year 2 Evaluation Report, March 2004-March 2005.* New York: The Center for Technology and School Change, Teachers College, Columbia University.

Meier, E., Powell, K., Moeller, B. & Dubitsky, B. (2005). *Setting the Stage for Reflective Practice: Multimedia Case Study Development.* Proceedings of the SITE International Conference, Phoenix, AZ March 1-5, 2005.

Moeller, B. & Brothman, A. (2005). *Designing Digital Video Case Resources for Mathematics Teacher Education*. Proceedings of the SITE International Conference, Phoenix, AZ March 1-5, 2005.

Powell, K. & Meier, E. (2004). *Mathematics for All*: *Year 1 Evaluation Report, July 2003-March 2004.* New York: The Center for Technology and School Change, Teachers College, Columbia University.

Moeller, B. & Dubitsky, B. (2004). *Mathematics for All: Annual Report to National Science Foundation.* New York: EDC/Center for Children and Technology. Available online at: http://www2.edc.org/CCT/publications_report_summary.asp?numPubId=191