MATH FOR ALL:
Broadening and Sustaining Effective Teacher Professional Development to Support Rigorous Personalized Mathematics Instruction for High-Need Students in Grades K–5

Proposal for a Mid-Phase Project Submitted to the Education Innovation and Research Program

Education Development Center, Inc.

in collaboration with

Bank Street College of Education
Deacon Hill Research Associates
Abt Associates
Teachers College, Columbia University
Chicago Public Schools
Illinois Regional Offices of Education # 39, #47, and #50
The Center: Resources for Teaching and Learning

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INTRODUCTION

Education Development Center (EDC), in collaboration with Bank Street College of Education (Bank Street College); Deacon Hill Research Associates (DHRA); Abt Associates (Abt); Teachers College, Columbia University (TC); Chicago Public Schools (CPS); three Regional Offices of Education (ROEs) and their school district partners; and The Center: Resources for Teaching and Learning (The Center) proposes a **mid-phase** grant to regionally expand Math for All (MFA) in diverse settings in Illinois that serve high-need students. We will address both **Absolute and Invitational Priorities 1 and 2**.

MFA is an intensive professional development (PD) program designed to help general and special education teachers in Grades K–5 to personalize rigorous mathematics instruction for a wide range of learners, including students who are low performing, and students with disabilities. MFA was developed by Bank Street College and EDC with funding from the National Science Foundation and is published by Corwin Press (Moeller et. al, 2011; 2012; 2013a; 2013b). A current IES-funded efficacy trial in Chicago Public Schools (Duncan, Moeller, Schoeneberger, & Hitchcock, 2018; not yet reviewed by the What Works Clearinghouse [WWC]) shows statistically significant positive effects of MFA on teacher preparedness and comfort in teaching students with disabilities, classroom practices, and on Grades 4 and 5 students' mathematics achievement (effect sizes range from 0.106 to 0.982). MFA incorporates several components that randomized controlled trials (RCTs) or quasi-experimental studies (QEDs) have shown to be effective for supporting elementary school teachers' professional learning and for improving student achievement, particularly teacher collaboration for instructional planning and peer coaching (cf. Stevens & Slavin, 1995; this QED met WWC 3.0 standards with reservations).

The overall goal of this project is to implement, test, and refine strategies for regionally expanding MFA in a variety of settings and with diverse high-need[1] populations in Illinois, and to build local capacity and infrastructure to support the sustainability and continued expansion of the program after this project ends. Building on Coburn's (2003) framework for scale, our strategies are designed to support the depth, sustainability, spread, and shift to local ownership of MFA, and include (1) training of local staff developers[2] and teacher leaders[3] as facilitators of the program, (2) inclusion of school leaders in the PD for facilitators and teachers, and (3) integration of MFA into the existing PD structures that are part of teachers' regular work schedules. Research efforts are designed to yield formative findings to help refine the scale-up strategies, provide evidence about MFA's effectiveness in a variety of settings and for diverse student populations, and supply information about the cost-effectiveness of the program.

A. SIGNIFICANCE

A.1. Severity of the Problem

Research shows that teacher quality is the single most powerful influence on student learning (e.g., Nye, Konstantopoulos, & Hedges, 2004; O'Dwyer et al., 2010; Rivkin, Hanushek, & Kain, 2005). **Yet teachers often are not well prepared to implement standards-based mathematics education with the heterogeneous groups of students often found in general education classrooms**, including students with disabilities and students with different capabilities and needs. In a national survey of science and mathematics teachers, Banilower et al. (2013) found that less than half (42%) of the elementary school math teachers felt well prepared

[1] Students who have a disability, low mathematics achievement, or low-income status.

[2] Staff whose primary job responsibility it is to provide PD to teachers.

[3] Teachers who lead other teachers in addition to classroom teaching responsibilities.

to plan instruction so students at different levels of achievement could increase their understanding. Less than a quarter of elementary school math teachers reported feeling well prepared to teach students with learning disabilities (23%) (Banilower et al., 2013).

Given teachers' lack of preparation to teach high-quality mathematics to diverse learners, it is not surprising that mathematics achievement in the United States is low, especially for high-need student populations. According to recent data from the National Assessment of Educational Progress (NAEP) (U.S. Department of Education, 2017), mathematics achievement levels for students with disabilities, and those from low-income families are among the lowest of all U.S. students (Exhibit 1).

Exhibit 1. 2017 NAEP Mathematics Assessment Results

Student Group Scoring Proficient of Higher	Grade 4	Grade 8
All Students	40%	34%
Low Income (National School Lunch Program)	25%	18%
Students with Disabilities	16%	9%

These numbers are alarming. Mathematics is essential to our functioning in everyday life and is a prerequisite to many 21st-century careers. Research has shown that mathematics achievement is closely linked with overall student success, such as achievement in high school, high school graduation, college readiness, and students' career aspirations (e.g., Belfanz, Herzog, & MacIver, 2007; Lee, 2012; Shapka, Domene, & Keating, 2006; Siegler et al., 2012). Thus, the low mathematics achievement of high-need student populations threatens to limit their opportunities to excel in an increasingly technology-based society.

A.2. National Significance

The proposed project is significant because it addresses **two critical areas of national need**: (1) improving teacher professional learning experiences, and (2) improving early learning of mathematics. It also promises to contribute to the knowledge base about a topic that has received

relatively little attention to date, namely how to prepare teachers for personalizing significant math content for heterogeneous groups of students with diverse strengths and needs.

The 2015 *Every Student Succeeds Act* (ESSA) strongly emphasizes high-quality PD, calling for PD that is "sustained (not stand-alone, 1-day, or short-term workshops), intensive, collaborative, job-embedded, data-driven, and classroom-focused..." (S.1177, §8002 [42]). This definition is aligned with the education field's Standards for Professional Learning (Learning Forward, 2011) and marks the federal government's recognition of the support teachers need in order to provide high-quality instruction that enhances students' college and career readiness. A recent study found that only 20% of PD and training for teachers meets the ESSA definition of "high-quality professional learning" (Combs & Silverman, 2016).

Improving teachers' capacity to enhance mathematics learning for all students is of central importance for education given its connection with future student achievement and economic opportunity (e.g., Duncan & Magnuson, 2011). A focus on improving mathematics achievement in the elementary grades is particularly important, as NAEP and state achievement data show that achievement gaps for high-need students arise early, and often widen significantly as these students progress through the grades. Preventing achievement gaps before they arise, or addressing them as soon as they occur, constitute important steps not only toward improving students' mathematics achievement, but also their opportunities in life.

While there is a great need to improve PD efforts, especially with regard to better preparing teachers for personalizing high-quality mathematics instruction, there is little rigorous evidence available yet to guide this process. Reviews of research on teacher PD (Gersten, Taylor, Keys, Rolfhus, & Newman-Gonchar, 2014; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007) attest to the paucity of relevant studies that link PD to student outcomes. We anticipate that the findings

from our research will make important contributions to the knowledge base about PD approaches that are effective for helping teachers to personalize mathematics instruction for students with diverse strengths and needs, and the contextual variables that influence their implementation.

A.3. Exceptional Approach to the Priorities for this Competition

MFA is a PD program that is designed to assist schools and districts in improving the mathematics achievement of K–5 students who have diverse strengths and needs. Building on a neurodevelopmental framework for learning (Barringer, Pohlman, & Robinson, 2010; Pohlman, 2008), and utilizing a lesson-study approach (e.g., Fernandez, 2005; Lewis, 2000; Lewis & Perry, 2017), the program teaches teams of general and special education teachers how to collaboratively plan and personalize mathematics lessons to support the achievement of all students (cf. Stevens & Slavin, 1995). MFA has been extensively piloted and field-tested with more than 500 teachers from urban, suburban, or rural school districts from eight different states (Moeller, Dubitsky, Cohen, & Melnick, 2016).

The MFA program consists of video case-based curriculum materials and learning activities that form the core of two workshop series for teachers. One workshop series focuses on Grades K–2, and the other on Grades 3–5. Each workshop series involves 30 hours of PD time and 20 hours devoted to workshop-related assignments that participants carry out in their classrooms, for a total of 50 hours of PD during the course of one or more school years. Participants in MFA are teams of general and special education teachers who serve the same students at their schools (see Appendix G.1 for more details about the content of MFA).

MFA differs from other commonly used approaches to PD in several important ways. (1) MFA is designed to help **enhance teachers' preparation to personalize instruction so they are able to better reach *all* students,** rather than focusing only on students with disabilities and

other high-need students. Helping teachers hone their observational skills to better understand the strengths and needs of individual students, and to adapt instruction based on deep understanding of mathematical goals and different students' strengths and needs and how they learn best, is expected to benefit all students. (2) MFA is **designed for both general and special education teachers, and an integral part of the PD is the collaboration between the two**. This contrasts with approaches that target general education and special education teachers separately, typically with general education teachers receiving PD in content areas and special education teachers in the delivery of instructional strategies (Birman et al., 2007). (3) MFA **integrates learning about personalizing instruction within a specific academic content area** (mathematics). This contrasts with other approaches, such as PD in differentiated instruction, that focus on the delivery of instructional strategies across the curriculum (e.g., behavioral management, use of assistive technology, inclusion teaching). (4) **MFA is more comprehensive and intensive** than the PD in which teachers typically participate to learn how to better meet the needs of students with disabilities. On average, teachers spend only 3.4 hours on this topic, typically in a single session (Birman et al., 2007). For this project, teachers will engage in 50 hours of PD over the course of two school years to embed MFA PD in teachers' regular work schedules. (5) MFA engages teachers in collaborative lesson planning to **help to personalize their existing curriculum**, rather than teaching them how to deliver a new curriculum.

By focusing on the scale-up of MFA, this project represents an exceptional and innovative approach for addressing two of the absolute and both of the invitational priorities of this competition. This project addresses **Absolute Priority One (Moderate Evidence)** by scaling up a PD program supported by at least two studies (Duncan et al., 2018; Stevens & Slavin, 1995) that meet WWC 3.0 standards with reservations, and that overlap in the settings (urban,

suburban) and populations (elementary school students, students with disabilities) of the participants who will be included in the proposed project. This project addresses **Absolute Priority Two (Field-Initiated Innovations—General)** by focusing on MFA, an intervention designed to improve low mathematics achievement especially for high-need students, a problem of critical national importance to the field. This project aligns with **Invitational Priority One (Personalized Learning)**, as MFA focuses on helping teachers to make mathematics instruction accessible to the wide range of students in their classrooms by tailoring it to individual students' strengths and needs, while maintaining the rigor of the content. It also addresses **Invitational Priority Two (Early Learning and Cognitive Development)** by focusing on the improvement of mathematics teaching and learning in Grades K–5.

B. Strategy to Scale

B.1. Demand for Scalable, Effective PD on Personalizing Mathematics Instruction

About $18 billion is spent annually on teacher PD, and a typical teacher spends 68 hours per year on district-directed professional learning, which usually are spread across multiple topics (The Boston Consulting Group, 2014). Yet, despite these investments, there has been little evidence that many PD efforts result in lasting changes in teachers' classroom practice or have an impact on student achievement (e.g., Darling-Hammond, Hyler, & Gardner, 2017; Gersten et al., 2014; Yoon, et al., 2007). The Every Student Succeeds Act (ESSA, 2015) requires that PD be evidence-based, which pushes districts to re-evaluate current investments and to thoughtfully select approaches to PD that have proven to be effective and that can be implemented at scale.

The demand for evidence-based PD approaches is particularly acute in mathematics, a high-stakes subject area in which students are heavily tested. Standards-based reform initiatives in mathematics education (CCSSI, 2010; NCTM, 2000), have introduced fundamental changes in

expectations about how mathematics should be taught and learned. Chief among these changes are (1) a shift toward teaching mathematics conceptually rather than procedurally, (2) an emphasis on mathematical practices (e.g., making sense of problems and persevering, reasoning abstractly, attending to precision), and (3) an emphasis on equity, with the expectation that all students, "*regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study—and support to learn—mathematics"* (NCTM, 2000). These expectations differ dramatically from the traditional ways in which mathematics has been taught, and in which many teachers learned mathematics themselves. Thus, standards-based reform has created a high demand for PD in mathematics, and in particular for PD that is focused on helping teachers provide personalized support to students with different strengths and needs.

The vast majority of PD efforts and funds are used by school districts for internal PD efforts (The Boston Consulting Group, 2014.) There are good reasons to have school and district staff, such as curriculum specialists, staff developers, coaches, or teacher leaders conduct PD for teachers, as they can offer teachers more personalized, contextualized, and sustainable support at scale than what external PD providers can offer (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009). There is a great demand for PD and resources for district-based staff developers and administrators, because very little attention has been paid to who teaches these local staff developers and the school leaders who are directing internal PD for teachers.

Recognizing this need, our school district partners eagerly signed on to this project, and have pledged significant in-kind contributions to enhance the preparation of their staff developers, teacher leaders, and school leaders to implement and support PD that is effective in helping teachers to improve mathematics instruction for diverse learners. (See Appendix C for letters of support.) In fact, Chicago Public Schools, our partner in the IES-funded efficacy trial,

wishes to continue our collaboration, in an effort to build local capacity and infrastructure to expand the implementation of MFA both within and across schools.

Sites for the proposed project are 54 high-need school districts[4] and 541 elementary schools across four different regions in Illinois, including 29 rural, 23 suburban, and 2 urban settings, a pool which is sufficiently large and diverse to recruit the numbers of schools (60–80) we need for each of our two cohorts, and that will allow us to balance the types of settings included in each sample. (See Appendix G.2 for school district data.) If necessary, we will recruit additional school district partners, enlisting the help of our partner, The Center, a technical assistance organization that provides PD to teachers and principals across Illinois and that is connected to a large network of schools and districts. We also will use presentations at the annual statewide Illinois ESSA conference, which is hosted by The Center, to share information about MFA and to further increase the number of schools and districts interested in participating in this project.

B.2. Specific Strategies to Scale That Addresses Past Barriers

There is a growing consensus among educators, researchers, and policy makers that high-quality PD is sustained, intensive, collaborative, job-embedded, data-driven, and classroom-focused, and that it requires a system-wide approach including the involvement of school leaders (e.g., Darling-Hammond et al., 2017; ESSA, 2015; Learning Forward, 2011; NRC, 2011). When these conditions are not met, PD will be difficult to scale. Three of the key barriers that we have encountered to scaling up MFA and to ensuring the depth, sustainability, spread, and local ownership of its implementation include (1) the use of program developers to implement the PD, (2) the lack of school leader involvement, and (3) the implementation of the PD outside of

[4] Districts with more than 14% of students with disabilities, more than 50% of low-income students, or more than 50% of 5th grade students scoring below the proficient level in math.

teachers' regular work hours. To address these barriers, we will take a systems-based approach towards implementation, utilizing the following strategies.

Training Local MFA Facilitators. School districts already conduct the vast majority of PD internally (e.g., The Boston Consulting Group, 2014), and this approach offers multiple advantages over having PD conducted by external consultants, who may have limited capacity to provide ongoing support and who may be geographically separated from teachers. Local staff developers and teacher leaders often have established, ongoing relationships with teachers and schools and are familiar with school district priorities; this allows them to provide sustained and contextualized support. Training local facilitators helps districts build internal capacity and ownership of the intervention, and enables them to spread the use of MFA within and across schools over time. In fact, MFA was developed with local facilitators in mind. Program materials that support facilitators in implementing the program have been published by Corwin Press.

Including School Leaders in the MFA PD. School leaders are essential for ensuring the depth, sustainability, and spread of MFA. School leaders need to provide teachers with sufficient ongoing collaborative lesson planning time and acknowledgement of, and feedback on, their work. School leaders have to perceive MFA as a school-wide initiative to foster collaboration among general and special education teachers and within grade levels and grade bands. Helping school leaders understand what implementing MFA involves and how they can support it, and having them work with local facilitators to create a plan for integrating the PD into their schools' existing PD schedules, helps all key stakeholders assume ownership of the program (cf. Clifford & Mason, 2013; Fink & Resnick, 2001; The Wallace Foundation, 2013).

Embedding MFA into Teachers' Regular Work Schedules. Providing teachers with opportunities for collaboration and professional growth during the school day has been identified

as one of the most strategic areas for improving the quality of teaching (e.g., 100kin10, 2018; Croft, Coggshall, Dolan, Powers, & Killion, 2010). Schools often have PD time throughout the school year, and may provide substitute coverage to let teachers attend PD during the school day. Embedding MFA into these PD structures has several advantages. It fosters school leaders' involvement in the PD because they have to make an active commitment to participate in the program. It allows teachers to experience the MFA PD as a school-based initiative, which raises expectations for their full participation, and reassures them that their work contributes to a valuable collective effort. Teachers also are able to fully benefit from collaborative lesson planning with colleagues who serve the same students. The timeframe for implementing MFA may need to be adjusted to school district schedules and calendars; for example, the existing PD schedules may not allow for the full 50 hours of MFA to be implemented in one school year. We are therefore planning for a two-year implementation timeframe. We do not anticipate this change will have any impact on the fidelity of implementation (FOI).

PD for MFA Facilitators and School Leaders. Drawing on research on best practices in professional learning and leadership development (e.g., Darling-Hammond, LaPointe, Meyerson, Orr, & Cohen, 2007; Sztajn, Ball, & McMahon, 2006), our activities utilize a content focus that (1) is aligned with professional standards and focused on instruction, organizational development, and change management; (2) uses problem-based learning strategies, such as case methods, and inquiry into practice; (3) includes mentoring and coaching that supports modeling, questioning, observations of practice, and feedback; and (4) incorporates collaboration among MFA facilitators and school leaders to facilitate teamwork and mutual support. We will engage these leaders in the following professional learning activities.

(1) A five-day MFA facilitator institute. We will be able to build on and refine a previously developed course for facilitators (see Appendix G.1). The facilitator institute will give staff developers the opportunity to experience the MFA PD sessions firsthand, to learn about key PD content and facilitation issues, and to discuss how to adapt MFA with integrity to local schools. It also will provide opportunities for community building among pairs of general and special education co-facilitators who will work together to implement the PD, and the larger cohort of MFA facilitators. School leaders will join the facilitator institute for at least one day, during which time will be dedicated to bringing them into the process (e.g., collaborating with the MFA facilitators to create a plan for the implementation of the PD at their schools).

(2) Ongoing support. For two years following their participation in the facilitator institutes, pairs of MFA co-facilitators will receive ongoing support from the program developers, including regular meetings throughout the school year to plan for and debrief MFA teacher PD sessions. These meetings will be conducted online and will be driven by the facilitators' needs and concerns (e.g., adapting PD activities based on teachers' needs, and providing feedback on teachers' work). MFA developers will also join the local facilitators in person during two of their MFA teacher PD sessions per year to support their implementation and offer feedback. School leaders will be expected to join during at least one of those sessions. We also will periodically reconvene the entire cohort of facilitators who participated in the facilitator institute together to foster community building and continued discussion of maintaining the integrity of MFA implementation. We will conduct two virtual meetings during the school year, and a one-day face-to-face meeting at the end of their first year of implementation. Finally, will identify at least one model school in each region and coordinate visits to these schools by facilitators and school leaders to help maintain a vision of what high-quality implementation looks like.

(**3) Online support environment**. The purpose of the support environment is to connect stakeholders (facilitators, school leaders, and teachers) with the MFA developers and with each other to allow for the exchange of ideas, experiences, and resources. We will utilize adaptive, mobile-friendly virtual support tools, such as Articulate 360's Rise platform, to ensure that the technology-based supports also can be readily embedded into the participants' work schedules. We will provide micro-PD resources such as short videos, animations, checklists, and other tools that provide immediate benefit to the staff. A resource section will include links to further readings, models for integrating MFA PD into various school contexts, the opportunity to conduct virtual visits to model classrooms and schools using video, alternative activities and extensions for PD sessions, and work samples, such as personalized lesson plans from teachers. The online environment also will host live and recorded webinars, which will focus on topics such as facilitation issues, mathematics content, and the specific needs of diverse learners.

B.3. Feasibility of Successful Replication in a Varity of Settings and Populations

We believe that it is highly feasible to expand the MFA implementation to an even larger scale because: (1) **Resources to support local facilitators in the implementation of MFA already are published,** a facilitator institute already has been developed, and additional resources (e.g., online support environment, models for adapting MFA to different school contexts with integrity) will be developed and refined as part of this project. After the completion of this project, we will continue to host the online support environment and offer MFA facilitator training through The Center and Bank Street College's Professional Education program to support staff developers across Illinois and the U.S. (2) Our previous work, involving the field testing of our strategies for supporting local facilitators with 48 staff developers from eight different states across the U.S., **demonstrated that they can be successfully used to help local**

staff developers implement MFA PD with fidelity in various settings and with diverse populations of teachers (Moeller, Brodesky, & Goldsmith, 2011). (3) **The mediator and moderator analyses being conducted will generate actionable findings** to help practitioners make decisions about MFA components to scale up or student populations to target. (4) **Embedding MFA PD within teachers' work schedules will help contain costs**, and the significant in-kind funds pledged by our school district partners show that school districts have the resources to adopt MFA PD. (5) **Partnerships with intermediary organizations**, such as the ROEs and The Center, and training their staff as facilitators will build their capacity to implement MFA PD, contribute to the regional infrastructure for MFA in Illinois, and support its continued expansion.

C. Project Design and Management Plan

C.1. Goals, Objectives, and Outcomes

The overall goal of this project is to build local capacity and infrastructure to support the depth of implementation, sustainability, ownership, and regional expansion of the MFA program in the state of Illinois. Exhibit 2 details the objectives and activities for pursuing this goal, as well as the measures we will use to document specific outcomes. We will be working with two cohorts of facilitators, schools, and teachers (Cohort 1: 2019–2021; Cohort 2: 2021–2023). The activities for each cohort will be the same (see Exhibit 4 for a timeline of activities).

Exhibit 2. Objectives, Activities, Measures, and Outcomes

Objective 1: Prepare and Support Local Facilitators and School Leaders for the Implementation of the MFA PD		
Activities	**Measures**	**Outcomes**
Recruit two cohorts of 40 general education and special education staff developers (20 pairs per cohort) as MFA facilitators.	MFA facilitator application, facilitator survey	80 qualified staff developers/ teacher leaders who are committed to serving as MFA facilitators
Conduct two five-day facilitator institutes for 20 facilitator pairs	Attendance records, session feedback forms, facilitator	80 trained MFA facilitators prepared to lead MFA PD

per cohort. The 60–80 leaders of the schools participating in the MFA PD in each cohort attend one day of the facilitator institute.	survey, MFA teacher PD implementation plans, school leader interviews	120–160 school leaders who are committed to support MFA PD implementation
Provide two years of ongoing support to 40 pairs of MFA facilitators (20 per cohort).	Attendance records, feedback forms, facilitator survey, facilitator interview, facilitator observation checklist	80 MFA facilitators receive support tailored to their specific implementation contexts and needs
Continually refine facilitator supports/materials from formative and FOI data.	Monthly project meeting notes, annual report on revisions made	Improved facilitator institute and ongoing support, refined facilitator and teacher materials
Objective 2: Implement MFA PD for Teachers with High Fidelity		
Activities	**Measures**	**Outcomes**
Work with district and ROE leadership and local MFA facilitators to recruit 60–80 schools and 320 teachers per cohort for participation in the MFA teacher PD.	School applications, signed memoranda of understanding, teacher consent forms	120–160 schools serving high-need student populations have made a two-year commitment to participate in the MFA PD
Pairs of local MFA facilitators implement the two-year PD with groups of 10–20 teachers each, including two full-day MFA institute sessions, and five two-hour lesson planning meetings per year. The 60–80 leaders of the participating schools in each cohort will participate in at least one day of the MFA teacher PD.	Attendance records, session feedback forms, facilitator observation checklist, facilitator logs, PD materials used (agendas, slides, handouts), teacher work samples, teacher survey, classroom observations using CLASS, teacher logs, student achievement data, plan for supporting ongoing teacher collaboration, school leader interview	80 facilitators implement the MFA PD with fidelity 120–160 school leaders gain an understanding of MFA and how to support teachers in their work 640 teachers are more prepared to personalize quality math teaching for diverse learners, leading to improved classroom practices and student achievement
Continually refine MFA PD based on feedback and on formative and FOI data.	Monthly project meeting notes, notes from meetings with local facilitators	Refined facilitator guide and teacher PD material, annual report on revisions made
Objective 3: Rigorously Evaluate the Impact of the MFA PD as Implemented by Local Facilitators to Meet WWC Standards Without Reservations (See Section D Below for More Details)		
Activities	**Measures**	**Outcomes**
Randomly assign two cohorts of 60–80 schools to K–2 or 3–5 PD conditions.	Lists of schools and teachers participating, demographic data about schools, teachers, students	Two cohorts of 60–80 schools randomly assigned to Grade K–2 or 3–5 PD (teachers in the grade band that is not participating in the PD serve in the Business as Usual [BAU] group) Findings regarding baseline equivalence between groups
Collect and analyze impact data from teachers and students.	Lists of teachers and students participating, teacher surveys, classroom observations using	CONSORT diagram documenting participation and attrition rates

	CLASS, student achievement data	Findings regarding group differences in teachers' beliefs and classroom practices and in students' mathematics achievement and engagement Findings on variables that mediate and moderate impact of MFA PD on teachers/students
Collect and analyze FOI data.	Facilitator logs, facilitator observation checklist, PD materials, work samples, attendance records, session feedback forms, teacher logs, classroom observations using CLASS	Findings regarding facilitators' participation in the facilitator training and the fidelity of their MFA PD implementation Findings regarding teachers' participation in the MFA PD and the FOI of MFA lesson planning and classroom practices
Collect and analyze data on teachers' non-MFA PD experiences in treatment and control groups to establish treatment contrast.	Teacher surveys, teacher logs, teacher and school leader interviews	Findings regarding differences in the content, format, and duration of MFA and BAU teachers' PD experiences, and whether cross-contamination is occurring
Collect and analyze cost-effectiveness data.	MFA and BAU PD program descriptions; interviews with MFA developers; surveys, interviews, observations, logs	Findings regarding cost and cost-effectiveness of the MFA PD compared to BAU PD
Refine study materials and procedures.	Records from weekly research team meetings	Improved materials and procedures for recruitment, data collection, and analysis; annual report on revisions made
Objective 4: Build Infrastructure for Continued MFA Expansion and Disseminate Findings		
Activities	**Measures**	**Outcomes**
Broadly disseminate information about the project and its findings through presentations at conferences and in publications.	Number of presentations conducted, number of publications, number of visitors to MFA website	Increased awareness among educators, researchers, and policy makers about MFA and its impact on teachers and students
Create online support networks for MFA facilitators, school leaders, and teachers.	Number of facilitators, school leaders, and teachers participating, frequency of the online interactions	Facilitators, school leaders, and teachers share experiences and resources, and learn from each other to refine their practice
Establish MFA model schools in different regions in Illinois and create video cases for MFA website and facilitator institutes.	Number of school visits conducted, school visit feedback form	Increased awareness among facilitators, leaders, and teachers with images of what high-fidelity MFA implementation looks like
Incorporate MFA facilitator training course into PD programs and broadly disseminate it at state and national level.	Number of staff developers/teacher leaders enrolled in facilitator institutes	Continued expansion of MFA beyond the duration of this project

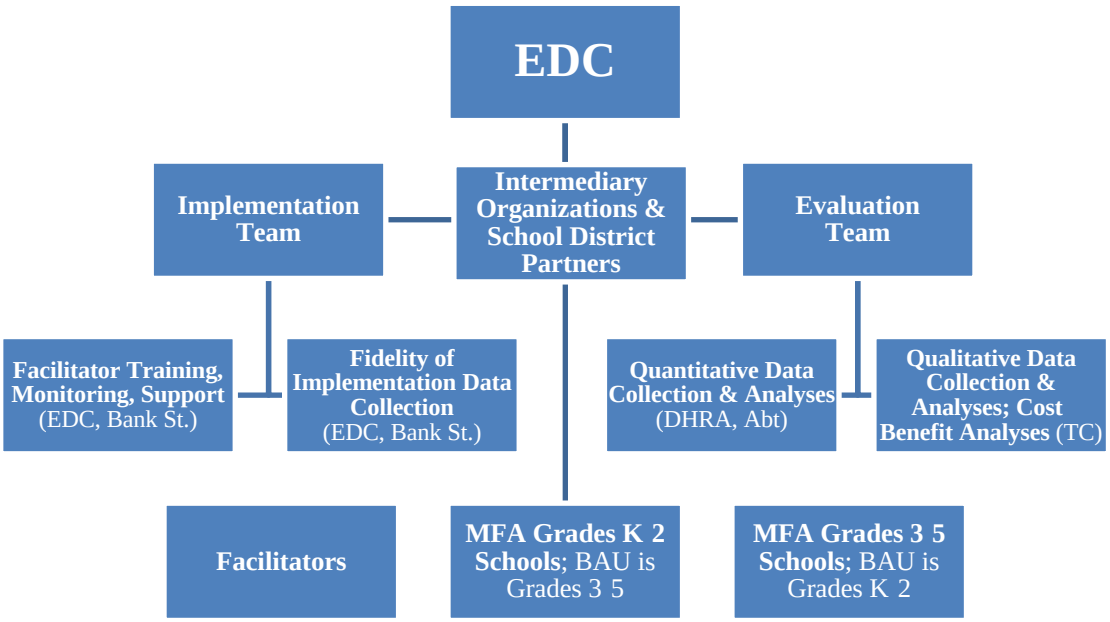
C.2. Management Plan—Responsibilities, Timelines, and Milestones

The project will be led by EDC, a nonprofit educational management organization with an exceptional 60-year track record in managing large-scale projects and completing them on time and within budget. EDC has made an institutional commitment to sound project management practices and has trained and certified 180+ staff in PMD Pro, including members of the EDC team leading this work. EDC will be building on ongoing, successful partnerships with several organizations. EDC, Bank Street College, and TC are submitting a group application, as described in EDGAR part 75.127. These partners will establish the necessary inter-institutional agreements in accordance with EDGAR part 75.128 guidance on establishing and operating inter-institutional grants. Abt , DHRA, and The Center will be subcontractors to EDC.

The organization chart shown in Exhibit 3 displays the relationships between the organizations, and Exhibit 4 shows major milestones, timelines, and who is responsible for each project activity. As the lead organization, EDC will oversee all project activities, administer this grant, and serve as the contact to the U.S. Department of Education. Staff from EDC and Bank Street College, including the developers of the MFA PD program, will serve as the implementation team, responsible for conducting the facilitator institutes for teacher and school leaders, providing follow-up support, monitoring FOI, and refining the facilitator and teacher resources. To ensure the objectivity of the evaluation, DHRA, in collaboration with Abt and TC, will lead the research efforts. They are not involved with the development of MFA PD or the MFA facilitator resources and have no financial interest in the outcome of the evaluation.

The research team, under leadership of DHRA and Abt and in collaboration with TC, will refine the research design and methods, assign schools to conditions, and collect, code, and analyze the data. DHRA and Abt will lead study design and quantitative data collection and

Exhibit 3. Organizational Chart



analyses. TC will conduct qualitative data collection and analyses through the Center for Technology and School Change (CTSC). Staff from the Center for Benefit-Cost Studies of Education (CBCSE) at TC will conduct cost-effectiveness analyses (CEA). CPS and three ROEs (#39, #47, and #50) will serve as implementation sites; will help recruit facilitators, school leaders and schools, and teachers; and will help with logistics of the facilitator institutes and the teacher PD sessions. District administrators from CPS and ROE #47 serve as co-principal investigators for this project and will contribute to ongoing planning for this project. CPS and the ROEs have pledged significant in-kind support to help carry out this project. Finally, The Center, a Chicago-based nonprofit organization that provides PD and technical assistance on working with high-need student populations to districts and schools across Illinois, will help us disseminate information about MFA and build a local infrastructure by incorporating the MFA facilitator institute into its ongoing PD program. Staff from all collaborating organizations will

Exhibit 4. Milestones, Timelines, and Responsibilities

Activities and Milestones	Y1	Y2	Y3	Y4	Y5	Who is responsible?
Project Management						
IRB review	●	●	●	●	●	EDC, DHRA, CPS
Weekly meetings of implementation team	●	●	●	●	●	EDC, BSC
Weekly meetings of research teams	●	●	●	●	●	EDC, DHRA, Abt, TC
Monthly meetings of project leadership team	●	●	●	●	●	EDC, DHRA, Abt, TC, CPS, ROEs
Meet with advisors	●	●	●	●	●	EDC, BSC, DHRA, Abt, TC, CPS, ROEs
Objective 1: Prepare and Support Local Facilitators and School Leaders for the Implementation of the MFA PD						
Develop and refine facilitator institute and resources	●	●	●	●	●	EDC, BSC
Recruit 40 staff developers/teacher leaders	C1	C2	C2			EDC, BSC, CPS, ROEs
Conduct two five-day facilitator institutes	C1		C2			EDC, BSC
Provide ongoing support to local facilitators		C1	C1, C2	C2	C2	EDC, BSC
Objective 2: Implement MFA PD for Teachers with High Fidelity						
Recruit 60–80 schools (320 teachers)	C1		C2			EDC, BSC, CPS, ROEs
Implement MFA-PD with teachers	C1	C1	C1, C2	C2	C2	CPS, ROEs, EDC, BSC
Refine MFA facilitator and teacher resources	●	●	●	●	●	EDC, BSC, CPS, ROEs
Objective 3: Rigorously Evaluate the Impact of the MFA PD						
Randomly assign schools to conditions	C1		C2			Abt, DHRA
Collect and analyze impact data	C1	C1	C1, C2	C2	C2	DHRA, Abt, TC
Collect and analyze FOI data	C1	C1	C1, C2	C2	C2	EDC, BSC, TC, DHRA, Abt
Collect and analyze treatment contrast data	C1	C1	C1, C2	C2	C2	DHRA, Abt
Collect and analyze cost effectiveness data	C1	C1	C1, C2	C2	C2	TC, DHRA
Refine study materials and procedures	●	●	●	●	●	DHRA, Abt, TC
Objective 4: Disseminate Findings and Build Infrastructure for Continued Expansion						
Conduct presentations and prepare publications	●	●	●	●	●	EDC, BSC, DHRA, Abt, TC, CPS, ROEs
Create online support networks for participants	●	●	●	●	●	EDC, BSC, CPS, ROEs, CTR
Establish MFA model schools			C1		C2	EDC, BSC, CPS, ROEs
Offer MFA facilitator institutes through existing PD programs					●	EDC, BSC, CPS, ROEs, CTR

C1=Cohort 1, C2=Cohort 2, EDC=Education Development Center, BSC=Bank Street College, DHRA=Deacon Hill Research Associates, Abt=Abt Associates, TC=Teachers College, CPS= Chicago Public Schools, ROEs= Regional Offices of Education, CTR=The Center

work as a team to disseminate information about MFA and our research findings, reaching a diverse community of interests at the research, policy, and practitioner levels.

Project staff are highly qualified to carry out the proposed work and bring extensive experience in teacher PD; math education; qualitative and quantitative research; product development and dissemination; and managing large-scale collaborative research and development efforts. Exhibit 5 details the experience and responsibilities of key personnel.

Exhibit 5. Roles, Experience, and Primary Responsibilities of Key Personnel

Role in Project	Experience and Primary Responsibilities for Project
Babette Moeller, PhD (50% FTE) Principal Investigator (PI)	• Distinguished Scholar at the Education Development Center • More than 30 years of experience conducting educational research, including serving as PI for an IES-funded RCT • Lead developer of the Math for All program • **Will oversee all project activities, co-direct the implementation team, and contribute to formative data collection and analyses**
Marvin Cohen, EdD (40% FTE) Co-Principal Investigator (Co-PI)	• Senior Faculty of the Mathematics Leadership Program at Bank Street College of Education with more than 30 years of experience • Co-developer of the Math for All program • **Will co-direct and coordinate the MFA implementation team**
Teresa Duncan, PhD (28% FTE) Co-Principal Investigator	• President and Founder, Deacon Hill Research Associates • Served as PD/PI on four RCTs funded by U.S. Department of Education • Has served as director of REL Mid-Atlantic (2012–2017), overseeing the development, implementation, and production of 47 analytic technical support projects and 18 applied research studies • **Will co-direct the MFA external evaluation team overseeing data collection and analyses for the quantitative impact analyses**
John Hitchcock, PhD (15% FTE) Co-Principal Investigator	• Principal Associate at Abt • Expertise in research design, analysis, program evaluation, technical assistance • Extensive experience leading large federally funded projects, including two RCTs funded by IES, which met WWC evidence standards • Serves as reviewer for the WWC • **Will co-direct the external evaluation team**
Ellen Meier, PhD (7% FTE) Co-Principal Investigator	• Associate Professor and Director, Center for Technology and School Change, Teachers College, Columbia University • **Will oversee the qualitative research to be carried out by staff from Teachers College, Columbia University**
Jessica Mahon (5% FTE) Co-Principal Investigator	• Director of STEM for Chicago Public Schools • Experience as a teacher, curriculum specialist, coach, and administrator • **Will be responsible for coordinating the implementation of the MFA in Chicago Public Schools**
Anji Garza (5% FTE) Co-Principal Investigator	• Director of Professional Learning for ROE #47 in Sterling, IL. • Experience as a teacher, curriculum specialist, coach, and administrator • **Will be responsible for coordinating the implementation of the MFA in School Districts served by ROE #47**
Fiona Hollands, PhD (7% FTE) Director of CEA	• Associate Director and Senior Researcher at the Center for Benefit-Cost Studies at Teachers College, Columbia University • **Will oversee the CEA, including data collection and analyses**

C.3. Procedures for Ensuring Feedback and Continuous Improvement

Several sources of feedback will inform the continuous improvement of the MFA resources, research design and methods, and project implementation, including (1) ongoing formative and FOI data (e.g., session feedback surveys, observations of PD sessions); (2) annual interviews

with a sample of stakeholders (e.g., school leaders, facilitators); (3) data from the impact evaluation with two cohorts of participants; and (4) input from an external advisory board.

Results from formative, FOI, and interview data will be reviewed on an ongoing basis by the project's leadership team. We will use monthly project meetings to discuss implications of emergent findings for improving the project's materials, activities, and procedures. Results from the impact evaluation with the first cohort of MFA participants will inform the refinement of the MFA PD resources and the research design and procedures for the second cohort.

We are pleased to have commitments from distinguished advisors, who bring expertise with PD, teacher education, math education, working with high-need student populations, and research design and methodologies. (See Appendix C for letters of commitment, and Appendix G.3 for biographical information). ***Mr. Robert Dumke,*** Director of The Center's The Technology Center for Teaching and Learning (TCTL); ***Dr. Allison Fahsl,*** Professor and Chair of the School of Education at McKendree University in Southern Illinois; ***Dr. Russel Gersten,*** Director of Instructional Research Group; and ***Dr. Christopher Rhodes,*** Associate Professor of Measurement, Evaluation, and Assessment, University of Connecticut. We will consult with the advisors individually and as a group through phone and Web conference calls and face-to-face meetings. Advisors will spend up to two days per year providing technical advice. They will review project activities and progress toward goals, suggest refinements to the MFA PD resources and research design and methods, review emerging findings, provide input on dissemination strategies, review reports and manuscripts prepared for publication, and help build a regional infrastructure for sustaining the implementation of MFA in Illinois after this project ends. Recommendations from the advisory board, and any changes in project design, MFA PD

resources for facilitators and teachers, and research materials and procedures will be summarized annually and included in our progress reports to the EIR program.

C.4. Integration of Project Purposes, Activities, and Benefits into Ongoing Work

As a result of this project, our school district partners and intermediary organizations (ROEs, The Center) will have a cadre of trained MFA facilitators, invested school leaders, access to model schools and support networks, and a cost-effective model for job-embedded MFA PD, which will help ensure the depth sustainability of MFA PD and practices. Local facilitators will be able to continue to implement the MFA PD with new cohorts of teachers and contribute to the expansion of the program in their area. School district partners and intermediary organizations also could explore how to apply the MFA PD model to other grade levels and subject areas.

Findings from this project will guide the ongoing refinement of the MFA PD resources and inform our work with other school districts and classes in teacher education. We will maintain and support the online environments and collaborative forums for MFA facilitators, school leaders, and teachers, and integrate them into work with other school districts. Bank Street College and The Center will incorporate the MFA facilitator institute into their teacher education classes and PD programs and offer it to interested teacher leaders. Our research partners will use instruments and procedures utilized in this project in future research and evaluation efforts. Findings from this project also will inform how we will go about further scaling up of MFA (e.g., what populations to work with, and in which settings), and what further research to pursue.

D. PROJECT EVALUATION

D.1. Methods Designed to Meet WWC Standards Without Reservations

The design of the impact evaluation builds on a previous efficacy study of MFA conducted in CPS and is guided by recent literature on replication research (e.g., Bonnet, 2012; Coyne,

Cook, & Therrien, 2016). Conducting more research in Chicago and expanding across Illinois will let us study the impact of MFA under conditions aligned with those of our previous study, while also extending it by (1) expanding into **different settings**, (2) including **additional populations**, and (3) **modifying elements of the implementation**. Findings from the proposed study consistent with results from the efficacy trial can offer evidence of the generalizability of MFA across settings and populations; findings that diverge from the results can show for whom and under what conditions MFA is more or less effective (Coyne et al., 2016).

An **independent team of highly experienced researchers** will conduct the impact evaluation. DHRA, Abt, and TC will address the following research questions, based on the MFA logic model (see Exhibit 8) and theory of change (Appendix G.1). (1) What is the impact of the MFA PD on teachers' **beliefs** (self-efficacy, preparedness in teaching students with disabilities)? (2) What is the impact of the MFA PD on teachers' **classroom practice**? (3) What is the impact of the MFA PD on **student achievement in mathematics**? (4) How is the impact of the MFA PD on student achievement in mathematics **mediated** by teachers' lesson planning and classroom practices? (5) How is the impact of the MFA PD on student achievement in mathematics **moderated** by school, teacher, and student characteristics (e.g., disability status)? (6) What is **the implementation fidelity** of the MFA PD and teacher practices? (7) What are the **successes and challenges** of the scaling strategies? (8) What is the **cost-effectiveness** of MFA PD compared to the PD received by teachers in the business as usual (BAU) condition?

Study Conditions and Random Assignment. The evaluation will consist of two RCTs, with schools randomly assigned to study conditions (which is appropriate, given MFA's focus on teacher collaboration under coordinated instructional leadership). Both RCTs will follow the same design (see Exhibit 6), where half of the schools will be assigned to have teachers in either

Grades K–2 *or* Grades 3–5 participate in the MFA PD (cf. Rochelle et al., 2014). Treatment schools that are randomly assigned to have their Grades K–2 teachers receive the MFA PD will be compared to schools where Grades K–2 teachers follow BAU routines (and where Grades 3–5 teachers are assigned to receive the MFA PD). Conversely, treatment schools that are randomly assigned to have their Grades 3–5 teachers receive the MFA PD will be compared to schools where Grades 3–5 teachers follow BAU routines (and where Grades K–2 teachers are assigned to receive the MFA PD). The first RCT will yield data to inform revisions and refinements to the scale-up strategies that will be assessed in the second RCT.

Designs where the treatment is delivered to subgroups within clusters (in this case, schools) raise concerns about the treatment spilling over into the control group, but we believe that **contamination**, if any, should be minimal. MFA PD is a complex intervention that consists of 30 hours of training and 20 hours of follow-up assignments, plus continuing support from

Exhibit 6. Study Design and Numbers of Participants by Cohort, by Year

Study Conditions within Each RCT		**RCT Contrasts**
30–40 schools where MFA is provided to Grades K–2 teachers	**30–40 schools where MFA is provided to Grades 3–5 teachers**	
Grades K–2 teachers who receive MFA PD over two school years	Grades K–2 BAU teachers whose Grades 3–5 peers receive MFA PD	MFA impact in Grades K–2
Grades 3–5 BAU teachers whose Grades K–2 peers receive MFA PD	Grades 3–5 teachers who receive MFA PD over two school years	MFA impact in Grades 3–5

	Year 1	**Year 2**	**Year 3**
RCT #1 (Cohort 1)	Two Facilitator Institutes (40 facilitators, 20 teams)	60–80 schools 640 teachers (320 T; 320 C) ~12,800 students (6,400 T; 6,400 C)	60–80 schools 640 teachers (320 T; 320 C) ~12,800 students (6,400 T; 6,400 C)
	Year 3	**Year 4**	**Year 5**
RCT #2 (Cohort 2)	Two Facilitator Institutes (40 facilitators, 20 teams)	60–80 schools 640 teachers (320 T; 320 C) ~12,800 students (6,400 T; 6,400 C)	60–80 schools 640 teachers (320 T; 320 C) ~12,800 students (6,400 T; 6,400 C)

facilitators. Teachers would not be able to communicate and transmit the intervention to their colleagues based on casual conversations. Indeed, the teacher PD literature has consistently found that PD without sufficient duration, coherence, and collective participation is unlikely to have any impact on instructional practice (Garet et al., 2016; Garet, Porter, Desimone, Birman, & Yoon, 2001; Yoon et al., 2007). As precautions, we will (1) instruct facilitators, school leaders, and teachers not to share MFA strategies across grade bands during data collection, (2) have local study staff monitor schools for any notable use of MFA strategies by teachers at the control group grade levels, and (3) examine teacher surveys and logs for evidence of contamination. Evidence of contamination will prompt action to prevent ongoing threats to internal validity.

Study Sample and Statistical Power. Each of the RCTs will involve 60–80 schools, 40 facilitators, and about 320 teachers and 6,400 students in each of the treatment and control groups. To be eligible, schools will have to meet these criteria: (1) common lesson planning time; (2) school leader involvement; (3) a commitment to keep teachers within the same grade bands during study (to the extent possible); and (4) use of the NWEA MAP test as a formative mathematics assessment in Grades K–5, given that Illinois has not yet announced which test will be used to replace the PARCC Assessment as its state assessment. Since the lowest grade that will be tested on the assessment is likely Grade 3, the impact analyses where the outcome is the new state mathematics assessment will be limited to Grades 4 and 5. This will ensure that we can use the prior year's state test scores (from Grades 3 and 4) as covariates in our impact analyses and improve our statistical power. Power analyses for teacher- and student-level outcomes are presented in Appendix G.4. Even with **conservative assumptions**, our minimum detectable effect sizes (MDESs) are reasonable. Depending on a 60- or 80-school scenario, MDESs for teacher-level outcomes range from 0.274 to 0.403 (teacher-level effects are often as high as 0.50,

according to Yoon et al. 2007), and from 0.208 to 0.359 for student-level outcomes. Given our strong relationships with CPS and the ROEs, and experience with recruiting schools and teachers for other RCTs, we are confident in being able to recruit and maintain the projected sample sizes.

Strategies to Guard Against Attrition. Low attrition rates (especially differential attrition between treatment and control groups) are important to ensure the internal validity of the study and allow our work to meet WWC standards. We will use several strategies to guard against attrition. (1) During recruitment, we will be explicit and clear in communicating expectations, to get buy-in from at least 75% of the teachers at each school. (2) We will overrecruit schools by 10% (i.e., recruit 66–88 schools to net 60–80). (3) We will conduct a commitment check among teachers and schools prior to randomization, to begin with intact clusters. (4) Local MFA facilitators will be working with schools; they are a trusted presence, who will emphasize the importance of the study to help retain teachers. (5) Local data collection staff will be making regular visits to the schools to encourage full participation in the data collection. (6) The study design allows *all* schools in the sample to receive the intervention, so this will help with study retention (cf. Rochelle et al., 2014). (7) Through our previous work, we have developed highly effective communication and data collection strategies leading to large response rates by treatment and control participants. Should we have attrition that exceeds the WWC threshold for acceptable attrition, we will use **multiple imputation** to mitigate missing data.

Data Analyses. Appendix G.6 specifies statistical models for RQs #1 through 5. Analyses of **impact on teacher outcomes** (RQs #1 and 2) will be based on a two-level intent-to-treat analysis (ITT) that includes all eligible teachers in randomly assigned schools, factoring in teacher- and school-level covariates and school-level random effects. Analyses of **impact on student outcomes** (RQ #3) will be based on a three-level ITT analysis that factors in student-,

teacher-, and school-level covariates and teacher- and school-level random effects. We will examine NWEA MAP and Illinois mathematics assessment scores at the end of the first and second years of each RCT to assess the impact of partial and full PD dosage. RQs #4 and 5 focus on **mediators and moderators** of the impact of the MFA PD; these analyses will involve multilevel modeling with cross-level interactions. **Implementation fidelity** (RQs #6 and 7) will be examined using a qualitative lens (see Appendix G.8) and descriptive and multivariate analyses, ranging from correlations and cross tabulations to ordinary least squares regressions and multilevel analyses. **Cost-effectiveness analysis** (RQ #8) based on the ingredients method (Levin, 1983) will document the costs of MFA PD implementation (i.e., cost per teacher, cost per student), as well as how costs vary across sites and numbers of teachers or students served. CEA will be used to contextualize any observed treatment effects (see Appendix G.7. for details).

D.2. Generation of Guidance About Effective Strategies Suitable for Replication

The proposed study involves schools in urban, suburban, and rural settings, varying in size and in their faculty and student populations (see Appendix G.2). Having a **large and diverse evaluation sample** will generate information that can guide schools and districts in whether, and how, to implement MFA, such as (1) how MFA fits into different school contexts and what supports are necessary; (2) how MFA can be implemented with fidelity; (3) the impact of MFA in different settings and for different populations; and (4) the costs to implement MFA.

Our **moderator** analyses will help us understand any **differential impacts** of the PD across settings and populations (RQ #5; student disability status is of particular interest). Examples of other moderators include student grade level, teacher certification and experience working with students with disabilities, and school leader support. Quantitative and qualitative **implementation data** from an array of sources, including facilitator and teacher surveys, school

leader and facilitator interviews, teacher logs, and observations of facilitators and teachers will help assess the effectiveness of the scaling strategy across various contexts (RQs #6 and 7) and refine the training and the resources/materials to support facilitators. **CEA** (RQ #8) will help inform districts and schools about the cost of MFA to achieve certain effects for teachers and students, and how those costs compare to the cost of BAU PD.

In **developing guidance about effective scale-up strategies**, we will frame our findings and discussion according to Coburn's (2003) framework of scale. This will allow us to take a more nuanced and reform-focused perspective on what it takes to promote the depth, sustainability, spread, and local ownership of MFA implementation.

D.3. Valid and Reliable Performance Data on Relevant Outcomes

Our mixed methods RCT approach of gathering data from multiple sources enhances our evaluation team's ability to triangulate our findings and reinforce the validity of the conclusions we draw. Appendices G.6 and G.9 include copies of the instruments we plan to administer and information about their psychometric properties. **Teacher beliefs** (RQ #1: self-efficacy, preparedness, comfort) will be assessed by self-report, Likert-scaled items from the teacher survey used in the MFA efficacy study (Cronbach alphas for these scales range from .788 to .950). **Teachers' classroom practice** (RQ #2) will be measured by observations using the CLASS protocol, a widely-used and validated instrument. **Student achievement in mathematics** (RQ #3) will be measured using the NWEA MAP formative assessment and the Illinois state test. Teachers' reports of lesson planning and classroom practices will be tested as **mediators** of the treatment effect on student math achievement (RQ #4). The MFA teacher survey includes two scales that measure classroom practice: instructional practices, and lesson planning practices (Cronbach alphas range from .835 to .908). School and student characteristics

will be taken from administrative data, and teacher characteristics will be gathered from the pre-test teacher survey to examine **moderating effects** in our data (RQ #5). **FOI** (RQ #6) is a multifaceted construct that includes adherence, dosage, quality of delivery, participant responsiveness, and program differentiation (Century, Rudnick, & Freeman, 2010). FOI will be assessed with a range of instruments, including workshop feedback forms, surveys and interviews of facilitators and teachers, facilitator and teacher logs, observations of PD sessions, and review of agendas and PD materials. Interviews of school administrators, facilitators, and teachers will document the **success and challenges of the scaling strategies** (RQ #7). The interviews with school leaders and survey, interviews, and log collected from facilitators and teachers will help us collect information for **CEA** (RQ #8).

D.4. Components, Mediators, Outcomes, and Threshold for Acceptable Implementation

Components, Mediators, and Outcomes. The design of the impact evaluation is informed by the MFA logic model (see Exhibit 7 and Appendix G.1 for theory of change). Key components of MFA include the use of a neurodevelopmental framework to help teachers better understand individual students' strengths and needs, and the demands of mathematics lessons; the use of video case studies of mathematics lessons to apply the neurodevelopmental lens to the analysis of classroom practice; and the collaboration between general and special education teachers to plan standards-based mathematics lessons that personalize instruction based on individual students' strengths and needs. Key teacher outcomes include enhanced self-efficacy, comfort, and preparedness to teach students with disabilities; and the ongoing collaboration between general and special education to plan personalized mathematics lessons. Improved achievement and engagement in mathematics are key student outcomes. Key mediating variables for student outcomes are teachers' lesson planning and classroom practices.

Measurable Thresholds for Acceptable Implementation. There are three levels of implementation that we must consider: (1) implementation of the MFA facilitator training, (2) implementation of the MFA PD by facilitators, and (3) implementation of MFA practices by teachers. As discussed above and demonstrated by the measures in Appendix G.5, we are assessing FOI/quality of implementation in multiple ways. However, **minimum** acceptable implementation thresholds are defined as follows. We expect facilitators to participate in all five days of facilitator training and to attend 80% of planning and debriefing meetings. The PD team will offer make-up sessions to facilitators who miss any training. Teachers participating in the MFA PD must attend at least 40 of the 50 hours of PD (80%) across two school years. Indicators of acceptable implementation of MFA practices by teachers will be reports of collaborative lesson planning and lesson adaptations in at least five of the eight teacher logs. These minimum thresholds will ensure the presence of inputs as described in the MFA logic model.

Exhibit 7. MFA Logic Model