A Technology-facilitated Scale up of a Proven Model of Mathematics Instruction in High Need Schools

Project Narrative for Investing in Innovation Scale-up Grant Application

Contents

Absolute and Competitive Priorities 1

Absolute Priority 2: Promoting Science, Technology Engineering, and Mathematics (STEM) Education. 1

Competitive Preference 8: Innovations to Address the Unique Learning Needs of Students With Disabilities and Limited English Proficient Students 1

Competitive Preferences Priority 10: Technology. 1

Project Narrative 2

A. **Need for the Project** 2

(1) The magnitude of the need for the services to be provided or the activities to be carried out by the proposed project. 2

(2) The extent to which the project represents an exceptional approach to the priorities established for the competition. 5

(3) The importance and magnitude of the effect expected to be obtained by the proposed project. 13

B. Quality of the Project Design 16

(1) The extent to which the proposed project has a clear set of goals and an explicit strategy, with actions that are (a) aligned with the priorities the eligible applicant is seeking to meet, and (b) expected to result in achieving the goals, objectives, and outcomes of the proposed project. 16

Project Goals 16

(2) The extent to which the costs are reasonable in relation to the objectives, design, and potential significance of the proposed project. 24

(3) The extent to which the services to be provided by the proposed project reflect up-to-date knowledge from research and effective practice 24

(4) The eligible applicant's estimate of the cost of the proposed Project 28

(5) The potential and planning for the incorporation of project purposes, activities, or benefits into the ongoing work of the eligible applicant and any other partners at the end of the scale-up grant. 28

C. Quality of the Project Evaluation 29

(1) **The extent to which the methods of evaluation will include a well-designed experimental study.** 29

(2) The extent to which the methods of evaluation will provide high-quality implementation data and performance feedback, and permit periodic assessment of progress toward achieving intended outcomes. 34

(3) **The extent to which the evaluation will provide sufficient information about the key elements and approach of the project so as to facilitate replication or testing in other settings.** 36

(4) **The extent to which the proposed project plan includes sufficient resources to carry out the project evaluation effectively.** 37

D. Quality of the Management Plan and Personnel 38

(1) **The adequacy of the management plan to achieve the objectives of the proposed project on time and within budget, including clearly defined responsibilities, timelines, and milestones for accomplishing project tasks, as well as tasks related to the sustainability and scalability of the proposed project.** 38

(2) The qualifications, including relevant training and experience, of the project director and key project personnel, especially in managing large, complex, and rapidly growing projects. 42

(3) The eligible applicant's capacity (e.g., in terms of qualified personnel, financial resources, or management capacity) to bring the proposed project to scale on a national, regional, or State level working directly, or through partners, either during or following the end of the grant period. 47

ABSOLUTE AND COMPETITIVE PRIORITIES

ABSOLUTE PRIORITY 2: PROMOTING SCIENCE, TECHNOLOGY ENGINEERING, AND MATHEMATICS (STEM) EDUCATION.

The proposed project will provide students with increased access to rigorous and engaging coursework in STEM via scaled-up implementation of a proven cooperative learning model of mathematics instruction, STAD-Math. This project also structures high-quality, multi-tiered professional development that establishes guided on-line and school-based professional communities of learning for teachers of mathematics in high need middle schools.

COMPETITIVE PREFERENCE 8: INNOVATIONS TO ADDRESS THE UNIQUE LEARNING NEEDS OF STUDENTS WITH DISABILITIES AND LIMITED ENGLISH PROFICIENT STUDENTS.

Many of the middle schools to be partners in the proposed project serve many limited English proficient students and students with disabilities. We will use proven cooperative learning and ESL strategies designed to help students with disabilities and LEP students succeed in mathematics in regular secondary classes.

COMPETITIVE PREFERENCES PRIORITY 10: TECHNOLOGY.

The proposed project will make innovative uses of computer, video conferencing, and other technologies to help teachers and students learn and use effective cooperative learning strategies in math. The use of technology will play a key role in enabling professional development to be provided in rural and urban areas in a highly cost-effective way.

PROJECT NARRATIVE

A. NEED FOR THE PROJECT

(1) THE MAGNITUDE OF THE NEED FOR THE SERVICES TO BE PROVIDED OR THE ACTIVITIES TO BE CARRIED OUT BY THE PROPOSED PROJECT.

The project proposed in this application is a partnership between Old Dominion University (ODU), several Local Education Agencies, the Success for All Foundation (SFAF), Johns Hopkins University, and MDRC to scale up and evaluate Student Teams-Achievement Divisions-Math (STAD-Math; Slavin, 1995). STAD-Math is an extensively researched, effective form of cooperative learning for middle school mathematics instruction. The project will take place in partnership with high needs schools across the U.S., including rural and urban schools serving students who live in poverty, students with limited English proficiency, and students with disabilities.

The mathematics performance of American students has improved in recent years, but it still remains unimpressive by international standards. In mathematics literacy, U.S. 15-year-olds rank 25th out of 34 countries (OECD, 2010+). In late elementary and middle school, many children show persistent deficiencies both in number combination skills (Chong & Siegel, 2009; Mazzocco, Devlin, & McKenney, 2008) and rational numbers (Mazzocco & Devlin, 2008). Over 80% of children who fail on basic tests of rational numbers (such as rank ordering fractions) continue to fail these tasks through 8th grade (Mazzocco & Devlin, 2008).

Particularly troubling is the steep decline in math proficiency that occurs when U.S. students transition from elementary to middle school. Between 1995 and 2007, the math achievement of U.S. students gradually improved, but our international competitors had much

higher average math achievement and were less likely to experience a decline in performance between fourth and eighth grade (TIMSS, 1995, 2003, & 2007).

The drop in math performance associated with the middle school transition is most powerful for groups of students who are traditionally under-represented in STEM career fields. For example, the percentage of students achieving advanced math proficiency in Virginia declines precipitously from 5th to 7th grade. The percentage of students achieving advanced proficiency in mathematics drops by half for virtually every group of students during this key developmental period, creating a massive and permanent crimp in the STEM career pathway. In a short span of two years, we lose from the STEM pipeline 61% of African American students, 23% of special education students, 58% of economically disadvantaged students, and 55% of students with limited English proficiency (VDOE, 2010).

As Gauss said, ―Mathematics is the queen of science." Mathematical understandings and attitudes obtained in middle school are prerequisite for successful participation in advanced STEM learning in high school, college, and beyond (Hanushek, Peterson & Woessmann, 2010). Improving middle school mathematics is imperative if we are to increase participation and success in advanced STEM coursework. Improvements in high school STEM curricula and instruction always will be limited by the number of students entering high school prepared to benefit from advanced STEM coursework.

There are significant negative lifelong and social consequences to mathematics underachievement, including negative effects on outcomes ranging from job attainment and success (Parsons & Bynner, 1997; Rivera-Batiz, 1992), to financial decision making and health-care risk assessment (Hibbard, Peters, Dixon, & Tusler, 2007), to social activities (McCloskey, 2007). Future career and life prospects for our most in-need students are highly dependent on

the effectiveness of the math instruction they receive. The fastest growing occupations in the next decade are projected to be in STEM areas that require advanced mathematical and scientific knowledge (Bureau of Labor Statistics, 2010; Hanushek, Peterson & Woessmann, 2010). We must ensure that our most in-need rural and urban poor students, students with limited English proficiency, and students with disabilities are given the opportunity to compete in this new economic arena.

A substantial body of research indicates that the "middle grades drop-off" in math learning is attributable to changes in instructional delivery modality and relationships in the math classroom that occur as students transition from elementary to middle school. These changes in instructional delivery cause culturally and linguistically diverse students, students with disabilities, and female students to drop out of the STEM pipeline (Alspaugh, 1998; Anderman, 1998; Anderman & Maehr, 1994; Eccles & Midgley, 1989; Midgley, Feldlaufer, & Eccles, 1989). The transition to middle school is accompanied by a shift in emphasis from flexible, small group work to whole-group instruction with a focus on individual competition and sorting by perceived aptitude (Midgley, Anderman, & Hicks, 1995). This cultural shift exacerbates performance deficits and reinforces the expectation that only a select few have the innate ability to understand and apply mathematical concepts. It undermines the self-confidence and motivation to study mathematics among girls, students with disabilities, and ethnically, racially, and linguistically diverse students. Women, minorities, and people with disabilities represent two-thirds of the American workforce, yet they are only a small fraction (about 10%) of those working in science, engineering and technology. We must provide explicit professional development in mathematics pedagogies that will support teachers in designing mathematics instruction that engages *all* students at the middle school level.

Many STEM-related fields, particularly those with the most attractive employment prospects such as medicine, engineering, or computing technology, require that professionals collaborate effectively to solve problems, generate ideas and innovate. Students who spend much of their school careers working individualistically in math are not well positioned to be effective scientists, mathematicians, engineers. There is a need to implement math instructional approaches that are different from "business as usual" to facilitate student engagement in complex problem solving, build higher level mathematical understandings, and cultivate the social skills and attitudes necessary for success in the STEM career pipeline. We propose to scale up a proven model of math instruction, STAD-Math, that not only addresses the specific math learning needs of middle school students and traditionally under-served, but also is proven to inculcate the social skills and dispositions needed for success in the STEM workforce.

(2) THE EXTENT TO WHICH THE PROJECT REPRESENTS AN EXCEPTIONAL APPROACH TO THE PRIORITIES ESTABLISHED FOR THE COMPETITION.

STAD-Math is grounded in research on cooperative learning, one of the most extensively researched and generally accepted approaches to pedagogy in mathematics. Research on cooperative learning in mathematics has found strong impacts on learning if the methods are carefully structured to incorporate two key elements: group goals and individual accountability (see Davidson & Kroll, 1991; Slavin, 1995; Slavin, Hurley, & Chamberlain, 2003; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003; O'Donnell, 2000; Slavin & Karweit, 1984; Johnson & Johnson, 1999). Recent comprehensive reviews of interventions in mathematics by Slavin, Lake, & Groff (2009) and Slavin & Lake (2008) found that STAD-Math had stronger effects on mathematics achievement than either computer-assisted instruction or curricular programs. The positive interdependence structured by the STAD-Math model

facilitates increased use of the higher level thinking strategies that are required for achievement in advanced mathematics courses (Gabbert, Johnson & Johnson, 1986; Johnson & Johnson, 2009; Johnson & Johnson, 1981b.; Johnson, Skon & Johnson, 1980; Skon, Johnson & Johnson, 1981). Shared social contexts provide support for students to construct mental models, solve problems, extend mathematics conceptual understandings, and build higher-order thinking skills (Bostic, 2010; Donald, 1991; Egan, 1997; Johnson & Johnson, 2009; Lave & Wenger, 1991; Mueller, 2009; Nebesniak, 2010; Nelson, 1996; Zakaria, Lu Chung & Daud, 2010). The content-specific discussion and collaboration embedded in the STAD-math model promotes higher level mathematical thinking (Zakaria, 2010).

Cooperative learning is especially effective with students from diverse cultural backgrounds, students with limited English proficiency, and students with disabilities (Cartledge & Kourea, 2008), because it makes instruction relevant and responsive to students' experiences, cultural perspectives, language backgrounds, and developmental levels (Diaz-Rico & Weed, 2010; Gollnick & Chinn, 2009). STAD-Math is supportive of culturally diverse learners because the instructional approach capitalizes on open patterns of peer-to-peer communication in learning (Delpit, 1995; Heath, 1983). STAD-Math supports learning for limited English proficient (LEP) students in part by providing more opportunities for both listening and speaking by students. This highly interactive model increases the repetition and modeling of language, which supports both basic interpersonal communication skills and cognitive academic language acquisition (Hakuta, 2011).

For students with disabilities, the peer interactions embedded in STAD-Math provide an opportunity for increased modeling, increased repetition, and increased social support. These features help prevent and reduce math anxiety, and establish a more engaging motivational

context for making the general mathematics curriculum accessible to students with disabilities (Browder & Spooner, 2006; Furner & Duffy, 2002). Typical peers' willingness to engage in social contact with students who have disabilities is enhanced in cooperative learning environments (Balkcom, 1992; Slavin, Madden & Leavy, 1984; Xin, 1996).

General education teachers are more likely to use class-wide interventions that support students with disabilities, such as STAD-Math, rather than highly individualized, specialized strategies that tend to be labor-intensive (Reichart, 2007). STAD-Math provides many more naturally integrated opportunities for curriculum overlapping of functional academic and social goals for students with significant disabilities than traditional whole class instruction (Browder & Spooner, 2006). This reduces the need for pull-out instruction, reduces potential distractions for all students in an inclusive classroom, and reduces the time teachers must spend planning alternate learning opportunities for students with severe disabilities, while ensuring that students with disabilities participate in the general education mathematics curriculum.

Although content knowledge is an important contributor to teacher effectiveness, it does not ensure effective pedagogy (Schectman, Roschelle, Haertel & Knudsen, 2010). Professional development that integrates pedagogical understanding and knowledge of content increases implementation of standards-based teaching (Ross, Hogaboam-Gray & Bruce, 2006). Increased teacher content knowledge, in the absence of effective, culturally-responsive pedagogy, will have little effect on student achievement for diverse students. The proposed model for professional development engages teachers in structuring their math classrooms to provide a learning context that is social, interactive, and highly engaging. These structures have been proven effective in enhancing important cognitive and affective constructs that contribute to learning and motivation for a range of diverse students (e.g., Barbato, 2000; Johnson & Johnson,

2009; Reid, 1992; Slavin & Karweit, 1985; Slavin, Lake & Groff, 2009; Slavin, Madden, & Leavey, 1984; Suyanto, 1998; Zakaria, Lu Chung & Daud, 2010). The National Council of Teachers of Mathematics (NCTM) has determined that this sort of interactive pedagogy is critical for math learning for *all* students (NCTM, 2008).

STAD-Math provides teachers and their students with specific guided tools for structuring effective peer interaction around mathematics to meet the social and cognitive developmental needs of middle school students. Middle school is a critical period for mathematical learning, as students are required to learn more complex and abstract concepts that set the stage for future learning (Roschelle et al., 2010). Middle school also is a period of intense and often difficult transition for students. Instruction tends to shift towards whole group and competitive interaction, away from social collaboration (Johnson, Johnson & Roseth, 2010; Midgley, Anderman & Hicks, 1995). This takes place during a developmental period when peer relationships actually become more important. In a recent meta-analysis of social interdependence of middle school students, the quality of peer relationships was found to account for 33 to 40% of the variance in achievement of middle schools students (Johnson, Johnson & Roseth, 2010). The shift from collaborative to competitive interaction that takes place as students transition through middle school is accompanied by a well-documented drop in achievement, most severely experienced by culturally and linguistically diverse students, students with disabilities, and female students (Alspaugh, 1998; Anderman, 1998; Anderman & Maehr, 1994; Eccles & Midgley, 1989).

Cooperative learning is widely supported by experts in mathematics instruction (NCTM, 1989, 2000, 2006; NMAP, 2008). Yet most teachers still do not use cooperative learning as a core strategy (Pianta et al., 2007). A significant proportion of teachers of mathematics *claim* to

use cooperative learning, but studies of actual applications of cooperative learning find that cooperative learning in mathematics generally consists of unstructured group work, with little individual accountability and no group goals (Stein, Grover, & Henningsen, 1996; Hiebert & Wearne, 1993). In the absence of structures to promote higher level interaction, the students often simply share answers rather than trying to explain ideas to each other (Antil et al., 1998; Emmer & Gerwels, 2002; McManus & Gettinger, 1996). Sharing answers without explanation has been found to inhibit, not aid, learning of mathematics in cooperative learning contexts (Webb & Palincsar, 1996; Webb, 2008). Our proposed project will provide an explicit model of cooperative learning that is adaptable to local curriculum and assessment programs. These features are associated with increased fidelity of implementation of instructional reforms (Nunnery, 1998; Desimone, 2002).

Investing in Innovation (i3) provides an opportunity to take a new and promising approach to improving math outcomes by implementing STAD-Math on a broad scale. This proposal describes a plan for scaling up Student Teams-Achievement Divisions (STAD-Math) for students in middle schools (Math 6 to Algebra I). It has the evidence base and the capacity to go to national scale that i3 envisions for its scale-up grants. The methods to be used reach directly into the heart of practice-- the interactions between teachers and students-- to improve daily lessons and school functioning, and then scale up cost-effective means of supporting improved practices to help many schools with large populations of high need students in both urban and rural communities across the nation.

Student Teams-Achievement Divisions (STAD) is a structured cooperative learning program in which students work in 4-5 member heterogeneous teams to help each other solve problems and build mathematical understanding. Teachers follow a schedule of teaching, team

work, and individual assessment. The teams receive ongoing feedback and recognition based on the performance of all team members on weekly assessments of understanding. This team recognition and individual accountability is essential for positive achievement effects of cooperative learning (Slavin, 1995).

STAD-Math can be used with any textbook or curriculum, making it flexible and easy to implement in various contexts. Our approach to professional development for implementing STAD-Math provides video modeling, for both students and teachers, of effective uses of cooperative learning, and electronically presented problem sets to be used in teams to meet standard objectives. The problem sets and introductory videos are shown by teachers using DVD or computer technology with large-screen monitors or projectors, or they are shown on interactive whiteboards. The sequence of problem sets and demonstration videos help teachers integrate content and pedagogy, and help student teams see on a regular basis how to help each other learn mathematics and how to focus their efforts on critical objectives.

STAD-Math currently is used in approximately 50 middle and high schools across the U.S. To reach the next phase of scale-up, we are proposing significant changes to the professional development model to reduce costs, encourage school-based ownership, and enhance sustainability. Currently, schools implementing STAD-Math tend to be widely dispersed, with just a few schools in each of many states and districts. Success for All Foundation (SFAF) coaches located around the U.S. provide extensive services to schools, traveling to schools for coaching and meetings. This is an effective but expensive training model, especially in rural schools. Coaches spend a lot of time traveling, and few coaches can provide more than 100 days of on-site service each year. In contrast, coaches who happen to live in the area where their schools are can typically spend 160 days per year in schools and can provide

more flexible service depending on schools' needs. Further, as long as coaching is provided by an external non-profit organization, it does not fully belong to the schools, but always exists at a distance from district leadership.

To reach the next level of scale-up, we propose to use i3 funding to support partner districts to develop their own embedded school-based math coaches and professional learning communities for STAD-Math. Staff from Old Dominion University (ODU) and the Success for All Foundation will train and certify these local coaches, who will then provide coaching to math teachers adopting STAD-Math in their own districts. Through formative study and implementation of a systems redesign process (Wilson & Daviss, 1994), ODU school reform, math instruction, and instructional technology experts will collaborate with colleagues at Johns Hopkins University to develop facilitative technologies that reduce the level of dedicated local coaching support necessary to implement STAD-Math with fidelity. The systems redesign process will reduce per-student costs through iterative improvements in the STAD-Math professional development and implementation support architecture with successive scale-up cohorts. The economies of going to scale locally or regionally are so great, and the anticipated economies derived from the technology-facilitated professional development model are so powerful, that meaningful savings can be passed on to schools. We expect that a reduced reliance on the provision of local or external resources for implementation support will increase program adoptions substantially in high poverty, high needs LEAs.

Our proposed approach to professional development uses school based math coaching, an on-line platform, and teacher-made videos of their own practices in a multi-tiered Professional Learning Communities (PLC) design (see Figure 1). This approach will reduce the on-site professional development costs of STAD-Math, especially in rural areas, making the program

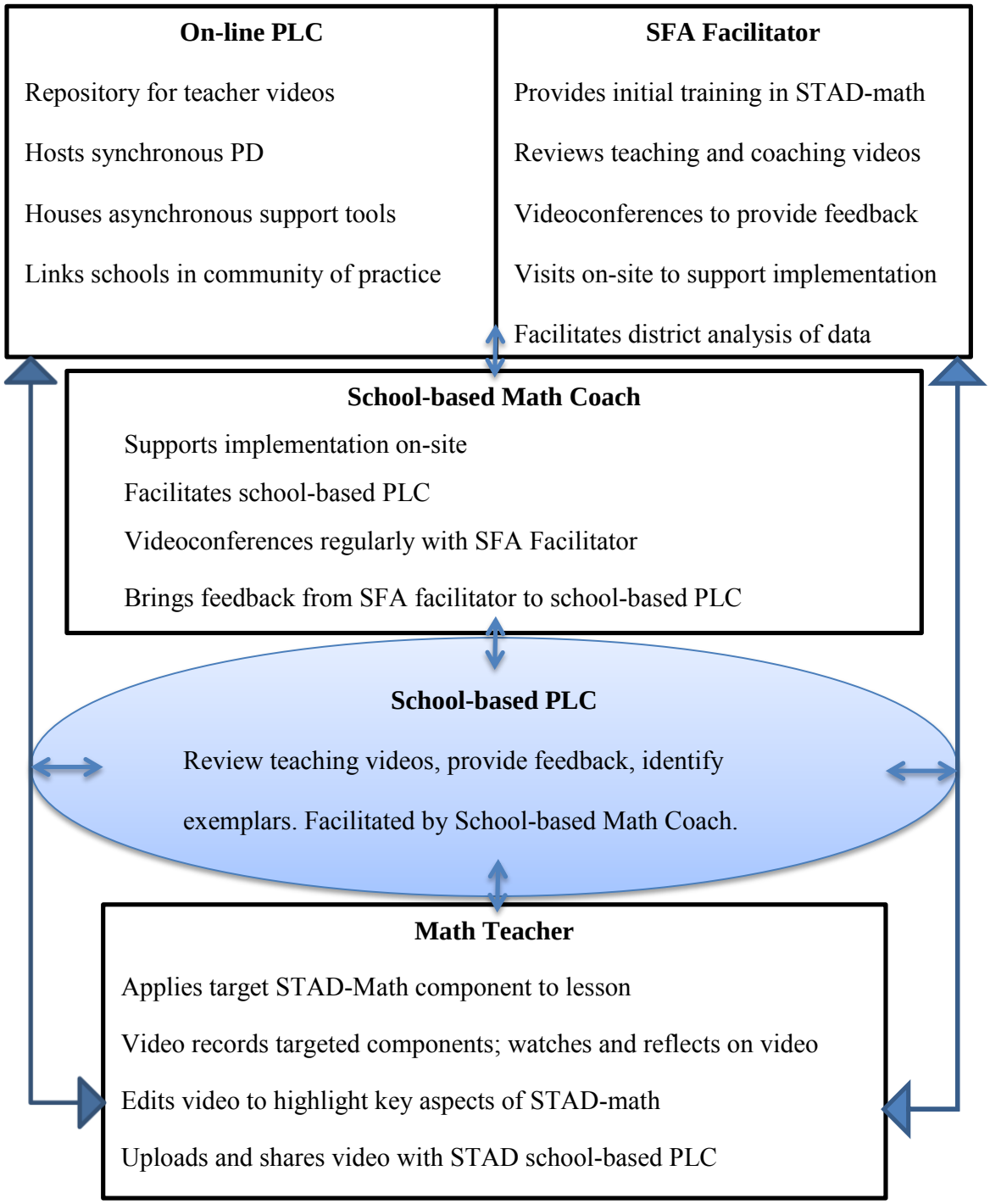

Figure 1. Conceptual Overview of Technology-facilitated Professional Development Model.

easy to adopt. It also embeds STAD-Math in school districts and provides inter-school networks of STAD-schools across the nation so educators may be empowered to rely on and learn from each other rather than rely on external consultants, thus reducing costs and building capacity within schools.

(3) THE IMPORTANCE AND MAGNITUDE OF THE EFFECT EXPECTED TO BE OBTAINED BY THE PROPOSED PROJECT.

STAD-Math clearly meets the i3 standards for strong evidence of effectiveness. Across four studies that meet both *What Works Clearinghouse* and best evidence synthesis standards, the sample size-weighted mean effect size for *STAD* in middle and high school math was +0.42. Effects of this size for widely replicated models, especially in studies by third-party evaluators, indicate a robust impact of practical and policy importance.

Slavin & Karweit (1984) carried out a large, year-long randomized evaluation of *STAD* in Math 9 classes in Philadelphia. These were classes for students not felt to be ready for Algebra I, and were therefore the lowest-achieving students. Overall, 76% of students were African American, 19% were White, and 6% were Hispanic. Forty-four classes in 26 junior and senior high schools were randomly assigned within schools to one of four conditions: *STAD, STAD* plus *Mastery Learning, Mastery Learning*, or control. All classes, including the control group, used the same books, materials, and schedule of instruction, but the control group did not use teams or mastery learning. Shortened versions of the CTBS in mathematics served as a pre- and posttest. The effect size comparing *STAD + Mastery Learning* to control was ES=+0.24, and that for *STAD* without *Mastery Learning* was ES=+0.18. There was no significant *Mastery Learning* main effect or teams by mastery interaction either in the random effects analysis or in a student-

level fixed effects analysis. Effects were similar for students with high, average, and low pretest scores.

Nichols (1996) evaluated *STAD* in a randomized experiment in high school geometry classes. Students were randomly assigned to experience *STAD* for the first 9 weeks of the 18-week experiment, for the second 9 weeks, or neither (control). The control group used a lecture approach for the entire 18-week period. At the end of 18 weeks, both *STAD* groups scored higher than controls on a measure of the content studied in all classes, controlling for ITBS scores (ES=+0.20, $p<.05$). In a randomized quasi-experiment, Barbato (2000) evaluated a form of *STAD* in tenth grade classes taking the New York State integrated mathematics course, Sequential Math Course II. Four sections were randomly assigned to experience STAD and four continued in traditional methods. All classes used the same textbooks and content, and differed only in teaching method. On the New York Integrated Math Test for Course II, controlling for Course I scores, students taught using STAD scored substantially higher (ES=+1.09, $p<.001$). Female students gained more than males from cooperative learning, but the gender by treatment interaction was not statistically significant. Reid (1992) evaluated an adaptation of *STAD* in an entirely African-American school in inner-city Chicago. Seventh graders who participated in cooperative learning were compared to matched control students. On posttests adjusted for pretests, the cooperative learning groups scored significantly higher on the ITBS (ES=+0.38, $p<.05$).

Indeed, fourteen randomized experiments or quasi-experiments have been conducted to ascertain STAD-Math effectiveness in diverse settings and with students of various age groups. We conducted a meta-analysis of effect sizes from these studies (see Appendix D for a complete description of the meta-analytic procedures). We estimated overall effects across elementary and

secondary school studies. The findings of this synthesis indicated that STAD-Math effects are consistent within grade levels, that they are positive and statistically significant at both elementary and secondary levels, and that STAD-Math has statistically significantly stronger effects in secondary schools (Cohen's $d = +0.34$) than in elementary schools (Cohen's $d = +0.11$).

Thus, a highly exclusive set of studies that meet both WWC and best-evidence synthesis standards for strong evidence indicate an average effect of STAD-Math on secondary students' math achievement of $d = +0.42$. A more inclusive meta-analysis of studies with high internal validity yielded an average effect of STAD-Math on secondary students' math achievement of $d = +0.34$, and a confidence interval that includes the average effect observed in the more exclusive set ($\delta_L = 0.22$ to $\delta_U = 0.46$). Further, STAD-Math effects for secondary students appear to be highly consistent as indicated by a lack of statistically significant within-class heterogeneity of effects.

Effects of this size for widely replicated models, especially in studies by third-party evaluators using standardized tests as outcomes, indicate a robust impact of practical and policy importance. To give a sense of perspective, the difference between African-American or Hispanic and White eighth grade mathematic scores on the National Assessment of Educational Progress is equal to an effect size of about 0.50. Based on the confidence intervals derived in the meta-analysis, STAD-Math has a 95% likelihood of closing between 44% and 92% of that gap.

B. Quality of the Project Design

(1) The extent to which the proposed project has a clear set of goals and an explicit strategy, with actions that are (a) aligned with the priorities the eligible applicant is seeking to meet, and (b) expected to result in achieving the goals, objectives, and outcomes of the proposed project.

Project Goals

(1). Scale up STAD-Math to 185 middle schools, reaching 135,000 students within five years. Working with our school district partners in high need urban and rural districts, we expect to add to the STAD-Math network a total of [redacted] 185 schools. At 600 children in a typical middle school (and 200 6th graders entering each year), about 135,000 students would receive STAD-Math during the project period. The project partners will build up capacity to serve larger numbers of middle schools after the grant period is over, enabling more schools to participate in the STAD-Math network each year.

School recruitment protocol. We will purposefully recruit schools targeted for school-turn around and/or those that are in need of improvement for participation in this scale-up. Within these initial criteria, we will focus on recruiting schools in NCLB school improvement status; rural low income schools; high poverty urban schools; schools in which the population of students with disabilities exceeds that which should be expected according to natural proportions; schools in which there is significant disproportionate representation of culturally, racially or linguistically diverse students in the population of students identified as students with

disabilities; and schools in which there is a significant population of students with limited English proficiency. We will work directly with state directors of school improvement, as well as through the extensive existing partnership networks of The Center for Educational Partnerships and the Success for All Foundation, to identify interested LEAs. We will conduct informational webinars, present at key stakeholder meetings (e.g., state superintendent association meetings) in states that express strong interest, and follow up with regional awareness and coordination sessions when we identify subsets of geographically contiguous rural or large urban LEAs expressing interest. We already have a letter of commitment from the Center for Rural Educational and Economic Development (CREED) to disseminate the program in either the Study or Scale-up phases to 22 isolated rural school divisions in central southern Virginia.

The pilot group includes five LEA partners with eight middle schools that in aggregate reflect the characteristics of the additional LEA partners we intend to recruit. Official LEA partners that will be included in the pilot group include Halifax County Public Schools (Virginia), Norfolk Public Schools (Virginia), Portsmouth Public Schools (Virginia), Judson Independent School District (Texas), and Unified School District 428 (Kansas). These LEA partners and the participating schools represent a broad range of high needs LEAs and schools, including a predominately African American rural school, a rural school with a substantial LEP population, five predominately African American urban schools, and a predominately Hispanic urban school (see Table 1).

Table 1

Demographic Characteristics of Pilot Schools in LEA Official Partner Sites

LEA Partner/ Schools	Locale	Disabilities	FRL	African American	Hispanic
Halifax County PS					
Halifax County MS	Rural	16%	67%	46%	2%
Norfolk PS					
Blair MS	Urban	14%	56%	67%	4%
Lafayette-Winona MS	Urban	17%	82%	87%	2%
Norview MS	Urban	15%	66%	75%	3%
Meadowbrook MS	Urban	15%	35%	44%	4%
Portsmouth PS					
Waters MS	Urban	14%	59%	66%	2%
Judson ISD					
Kirby MS	Urban	16%	81%	26%	61%
Unified School District 428					
Great Bend MS	Rural	11%	52%	2%	29%

The median percentage of students eligible for free or reduced-price lunch in these schools is 58%, and the median percentage of students with disabilities in these schools is 15%.

These schools have a median of 16% fewer students achieving proficiency in mathematics relative to their respective state averages.

(2). Deploy a technology-facilitated guided Professional Learning Communities model for STAD-Math Implementation within schools. Regularly-meeting STAD-Math professional learning communities (PLCs) of mathematics teachers will be convened in each partner school for the purpose of professional learning, planning and problem solving in the implementation of the STAD-Math program. The PLCs will be facilitated and guided by the school-based, embedded STAD-Math coach, with regular support from ODU and SFAF staff. These PLCs will build on the knowledge, skills and lived experiences of teachers in their context, and provide opportunities for peer professional modeling, support and interaction around real problems of practice, while still providing the external support and guidance necessary for fidelity of implementation of the program.

(3). Develop video-analysis and video-conferencing models to support STAD-Math professional development for local coaches and teachers. We will use video facilitation in this project to make efficient and cost effective use of SFAF coach resources and to provide professional development that supports school-based, embedded math coaches and the teachers they serve in local STAD-Math PLCs. After learning about a specific key component of STAD-Math, classroom teachers will implement the key component and record videos of short lesson segments that demonstrate their implementation of that program component. They will watch their own video, edit using simple editing software as needed, and use a guided reflection tool to reflect on their teaching and generate questions. Teachers will then upload these videos on a secure server for viewing by their coach and their peers at regularly scheduled meetings of their school-based professional learning community (PLC).

Local STAD-Math PLCs will select exemplar videos for various key components of STAD-Math over time, which the coach will upload to a secure server for discussion with SFAF coaches. Video conferences among the school-based coaches, SFAF coaches, and teachers will be held during the school year to discuss instructional strategies and student interactions. Coaches periodically will video sessions of their facilitation of the local PLC meetings, which will be uploaded for SFAF coaches to review and provide both written and video-conferencing feedback to the school coaches on their coaching skills in support of STAD-Math implementation.

(4) Deploy an on-line Professional Learning Community platform to increase high quality, sustainable professional development opportunities for math teachers. This platform will serve as the cyber-space repository for teachers to upload and hold their teaching videos for microanalysis and reflection. The online PLC will host STAD-math webinars and other synchronous and asynchronous support tools for implementing STAD-Math, including a video library of best practice lessons. The on-line PLC will link schools in a common community of learners to expand capacity, encourage sharing of resources, and increase sustainability. Specific elements of this approach to professional development include use of multimedia rich demonstration modules for teachers and students, mediated discussions in an online learning community, and teacher-driven discussion and development of professional learning resources.

Multimedia-Rich Demonstration Modules. A database of professional development modules that utilize live-action video and other media will help to model all program elements and responses to typical problems. Some of the modules will be used in initial workshops, and all will be easily accessible via the online PLC. We will develop additional video material for use

in new STAD-Math schools to illustrate each aspect of the program. These videos will model for teachers how each program element looks when it is implemented well. Videos will be used to show students specifically how they can facilitate each other's learning through metacognitive-dyadic and group-cooperative learning strategies.

Mediated Discussions in On-line Learning Communities. Teachers using STAD-Math will participate in online discussions organized as webinars that utilize the videos created in the project to raise issues for discussion, model effective strategies, and identify common problems. Some of these will be webinars in which STAD-Math experts will make presentations and conduct discussions on issues of common concern, such as adaptations for English language learners, classroom management challenges, and dealing with math misconceptions. In each case, participants will view video examples, ask questions of the presenter and of each other, present their own video examples, and engage in rich, practice-focused discussion. Feedback and questions that emerge during the webinars will inform both the development of additional content resources and the topics of future discussions. Webinars will be followed up with facilitated, asynchronous discussion around the webinar's main topic. Transcripts, audio, and video from the webinars will be edited for length and posted to the online PLC for teachers who were unable to participate in real time.

Participant-Driven Resources and Discussion. The online learning community will provide tools and protocols that encourage participants to post their own content, raise issues for group discussion, and support each other's professional learning. Teacher-submitted content may also be used during formal mediated discussions. For example, during a webinar on STAD-Math lessons, teachers might click on icons to see examples that worked for other teachers, problems and pitfalls, and commentary from both the submitting teachers and others who may have

provided feedback or added their own examples. Project coaches may also post commentary on the examples and the discussion. Teachers will utilize the discussion forum to continue dialog with teachers in schools other than their own. Project staff will monitor these discussions to identify issues that may require more focus, and with the permission of the teachers involved, discussions may be packaged and presented as a content resource in the searchable library. This type of mediated cross-fertilization of effective local adaption of proven practice contributes both to implementation fidelity and sustainability of educational reforms (Stringfield, Reynolds, & Schaffer, 2008).

(5). Utilize a systems redesign process to make evolutionary improvements to the technology-facilitation infrastructure, and iterative improvements in scale-up efficiency. The proposed technology support system incorporates a rich collection of multimedia resources and a framework of tools, protocols, and approaches that support discussion, collaboration, and coaching for teachers implementing STAD-Math. The systems redesign process will focus on the development, implementation, and refinement of these components. An inter-institutional, interdisciplinary *Systems Redesign Workgroup* will be formed to include (a) a systems redesign team from Old Dominion University, comprised of a *strategic planning and school restructuring expert*, a *teacher professional development specialist*, a *math coach specialist*, an *educational psychologist and formative evaluation expert*, and an authority *on instructional design and professional learning*; (b) *scale-up*, *multimedia production*, and *professional development experts* from Success For All Foundation; (c) *cooperative learning, scale up, e-learning*, *educational technology*, and *distance learning* experts from Johns Hopkins University.

The ODU systems redesign team will collect, analyze, and synthesize multiple sources of information to identify constraints on the effective and efficient utilization of technology-based

implementation supports. The *Systems Redesign Workgroup* will then meet periodically to review findings of the systems redesign team, prioritize redesign goals, and iteratively refine implementation supports and processes. A total of four systems redesign cycles will be implemented during the course of the project. In addition to extensive online data to be collected in the course of implementation, the systems redesign team will collect data directly from SFAF coaches, school-based math coaches, math teachers, and administrators in the pilot middle schools and through purposive sampling of 4 diverse school sites in subsequent implementation cohorts. The systems redesign team will focus on feasibility, usability, effectiveness, and efficiency of the technology-facilitated scale-up supports, addressing the following questions:

Feasibility: To what extent is the technology-supported PD and online learning community well accepted and used by project participants? How satisfied are project participants that the multimedia-rich PD modules, videos, animated simulations, and online mediated discussions address relevant and useful topics? How satisfied are project leaders, staff, and discussion facilitators with the content and technology tools available to them to support project participants? To what extent do project participants generate and contribute content to the learning community? To what extent do project participants attend and actively contribute to the scheduled online webinars? To what extent is the SFAF coaching component accepted, used, and supported by school administrators?

Usability: How do project participants evaluate the online learning community user interface in terms of ease of navigate and use? What are the barriers, technical or otherwise, to the usability of the media-rich PD modules and the online learning community? What are the barriers to accessing or contacting the coaches (e.g., rapport or utility of advice offered)? What occurs during the coaching sessions and does it align with teacher needs?

Effectiveness: What do project participants believe about the impact of PD resources and learning communities on the quality of their teaching of STAD-Math? To what extent do participants attribute quality instruction or student performance to the coaching provided in the program? How does regular participation in the technology-supported PD for STAD-Math lead to improved teacher quality in middle school math? How does regular participation in the technology-supported PD for STAD-Math lead to improved performance in math by students at-risk of school failure, particularly LEP and disabled students?

(2) THE EXTENT TO WHICH THE COSTS ARE REASONABLE IN RELATION TO THE OBJECTIVES, DESIGN, AND POTENTIAL SIGNIFICANCE OF THE PROPOSED PROJECT.

This project aims to increase the math performance of approximately 135,000 middle school students across the United States, to dramatically increase the efficiency and capacity of one of the nation's leading providers of proven educational reform models, and to create a technology-facilitated platform for instantiating effective educational practice that can be readily adapted to other interventions or for other providers. We believe that a total cost of $196.30 per student and an expected effect size of $d = +0.34$ across such a large population of students is reasonable in and of itself, but the additional benefits of a 35% long-term reduction in scale up costs and creation of a provider-portable technology-based platform for taking innovations to scale are especially compelling from a value standpoint.

(3) THE EXTENT TO WHICH THE SERVICES TO BE PROVIDED BY THE PROPOSED PROJECT REFLECT UP-TO-DATE KNOWLEDGE FROM RESEARCH AND EFFECTIVE PRACTICE

This project will establish both in-school professional learning communities and an online PLC for mathematics teachers implementing STAD-Math. These structures incorporate features of effective professional development for improving teacher practices, which include a

focus on content, active learning, coherence, duration, and collective participation (Bausmith & Barry, 2011; Desimone, 2009). The school-based PLCs and on-line PLC offer opportunities for teacher teams to work collaboratively on student learning, which has been found both to improve teacher practice and positively effect student achievement (Saunders, et al., 2009). Other research-based features of this project include sustained professional development (Yoon, Duncan, Lee, Scarloos & Shapley, 2007) and a focus on *how* students learn math content (Dopplet et al., 2009; Kennedy, 1998). The on-line PLC component integrates the latest research in the field of on-line learning technologies. On-line PLCs provide teachers with increased access to professional development tools and supports (Salazar, Aguirre-Munoz, Fox & Nuanez-Lucas, 2010). The on-line PLC platform also will provide increased opportunities for participating teachers to interact with other STAD-Math teachers from schools across the nation, to share expertise, information, dialogue, problems of practice, and creativity. This will increase opportunities for teachers to engage in professional development and to direct their own levels and pathways of engagement, while reducing costs and increasing the portability of professional development (Salazar, Aguirre-Munoz, Fox & Nuanez-Lucas, 2010).

PLCs that include peer-based networking and collaboration tools for educators provide for sustained, job-embedded professional development. This increases the likelihood of real impact on classroom practice and student learning, and the sustainability of instructional improvements (Oxley, 2006). Learning communities that include participant-driven content and interaction offer support for individual and collaborative experimentation and reflection, while simultaneously encouraging collegiality and professional growth (NCTAF, 2003). Recent conceptualizations of distance learning platforms provide a framework for ensuring self-

regulated learning of new practices in online PLCs (Abras & Sunshine, 2008; Bol & Garner, 2011, in press).

The proposed project will provide frequent opportunities for teachers to interact with SFAF coaches, school-based coaches, and other colleagues through synchronous and asynchronous, mediated, online discussions focused on specific professional development topics. For a professional development experience to be most effective, individuals should be provided frequent opportunities to interact with the instructor and their fellow participants (National Staff Development Council, 2001). Brown & Munger (2010) analyzed online forums that were unstructured and autonomous versus discussion forums that were facilitated and moderated, finding that mediated discussions resulted in more detailed, richer, less superficial dialog. Peer-to-peer dialog and collaboration allow participants to share classroom experiences and situations where instructional challenges are addressed and obstacles overcome (Keegan, 2007). Frequent, mediated discussions in PLCs can address issues that relate directly to a teacher's practice (Whitehouse, McCloskey, & Ketelhut, 2010). They can also promote a tighter integration of theory and practice by addressing real-time needs while not removing the teacher from the classroom context (So, Lossman, Lim, & Jacobson, 2009). Multimedia components developed through this project will provide just-in-time models of effective instructional techniques within a participant-centered professional learning community (Kilbane, 2001; Lowry, 2007). Fisher et al. (2010) found that teachers who participated in multimedia-enhanced online PD performed better on national tests and reported higher satisfaction. Participants in a study conducted by George-Palilonis and Filak (2010) found that instructional concepts presented in multimedia format were more engaging and easier to visualize, synthesize, understand, and remember.

Our scale-up plan is designed to gradually turn over to local coaches the primary responsibility for professional development in STAD-Math. The *Systems Redesign Workgroup* will create and implement solutions to provide more efficient coaching support through facilitative technologies and reconfiguration of existing local resources. Math coaches can play a vital role in strengthening math instruction and learning in a school (Hull, Balka & Miles, 2010). One of the core goals for effective math coaching is to build trust and rapport with teachers; another is to develop collegial partnerships for planning analyzing and reflecting on instruction; a third is to support and sustain institutional change (Hull, Balka & Miles, 2010). All of these things are challenging to do as an outside consultant with limited time to spend in a school. Furthermore, researchers have found that teachers need ways to learn from coaches that do not add to the time pressures they already feel (Dempsey, 2007). Scheduling meetings for multiple teachers with outside consultants for professional development can be so difficult and disruptive to teachers' schedules that extent coaching becomes ineffective.

To enhance the ability of coaches to accomplish the core goals of coaching during and beyond the duration of the i3 grant, we are proposing to train district embedded math coaches who are regular employees of the district. SFAF coaches will support local coaches in their efforts to use and help other math teachers effectively implement STAD-Math through on-site professional development, which will be augmented significantly by effective use of videoconferencing technologies.

Video conferencing offers a research-based, viable supplement to face-to-face facilitation. Properly employed, video conferencing, telementoring, and teleconferencing are effective means of providing professional development to teachers (Ardley, 2009; Burgess & Mayes, 2008; Israel et al.,2009). These techniques already have been shown to be effective for

improving practice in medicine (Rogers et al., 2001; Simonson, Smaldino, Albright & Zvacek, 2009). Use of these technology supports is especially important for the efficient provision of expert coaching to teachers in isolated rural school districts (Kendall, 1992).

(4) THE ELIGIBLE APPLICANT'S ESTIMATE OF THE COST OF THE PROPOSED PROJECT

The grand total cost per student for this project is $196.30 (all grant expenditures divided by the number of students served). Overall project start-up costs are $20.55 per student served, with accumulating annual cost per students in years 2, 3, 4, and 5 of $32.67, $45.20, $49.27, and $48.60. From a school-level perspective, assuming a middle school of 600 students and provision of external support for four years, start-up costs are $34.20 per student. Costs per student for post project scale up will be $88.03 per student. Current average total cost per student for STAD-Math implementation (i.e., prior to achieving expected efficiencies through utilization of online professional development components) are $135.07. Thus, the systems redesign process and utilization of online professional development components is expected to reduce per-student costs to approximately 65% versus current costs, primarily by reducing the costs associated with on-site facilitation provided by SFAF coaches. Costs to scale up to 100,000 students would be $8,803,000; to 500,000 would be $44,015,000; and to 1,000,000 would be $88,030,000.

(5) THE POTENTIAL AND PLANNING FOR THE INCORPORATION OF PROJECT PURPOSES, ACTIVITIES, OR BENEFITS INTO THE ONGOING WORK OF THE ELIGIBLE APPLICANT AND ANY OTHER PARTNERS AT THE END OF THE SCALE-UP GRANT.

This project will have substantial and lasting benefits not only for the current partners, but for scale-up beyond the grant period and scale-up of any program in any subject. The models, technologies, and lessons learned from the systems redesign process will increase the

capacity and efficiency of the Success for All Foundation to scale up proven effective educational models, making high quality, sustained professional development available at greatly reduced costs to school districts. The Center for Educational Partnerships at Old Dominion will benefit by having a platform for scaling its innovative models for data utilization for school improvement, co-teaching, inclusion, middle school science education, and education and social emotional supports for military children beyond initial pilot sites to other locations in the Commonwealth of Virginia. The Center for Technology in Education at Johns Hopkins will benefit by having four cycles of redesign improvements that will yield a reform-portable framework and technology infrastructure that can be used to facilitate scaling up other proven models.

C. QUALITY OF THE PROJECT EVALUATION

(1) THE EXTENT TO WHICH THE METHODS OF EVALUATION WILL INCLUDE A WELL-DESIGNED EXPERIMENTAL STUDY.

The evaluation of the implementation and impact of STAD-Math will be conducted by MDRC, which is completely independent of Old Dominion University and SFAF. MDRC will be solely responsible for random assignment of schools to treatment conditions and will inform both the schools, ODU, and SFAF of the final outcome. MDRC will collect all measures of student outcomes and be solely responsible for the analysis and interpretation of findings. MDRC will seek comments and suggestions from the program developer on draft reports but its technical review process and quality control systems will provide the final review of evaluation products.

The independent third-party evaluation will include a rigorous cluster Randomized Controlled Trial (RCT) to measure program impacts. A total of 40 Title I middle schools that

have been designated by their respective states as either in corrective action or restructuring under NCLB will be recruited from geographically diverse districts and randomly assigned to either a treatment group implementing STAD-Math or a control group continuing with business as usual. Students will be followed over three years and assessed on mathematics skills each spring, either by a special evaluation test or through state math assessments. The implementation research, discussed below, will assess treatment fidelity and the treatment-control instructional contrast.

Research Questions. To reduce concerns about multiple hypotheses testing producing statistically significant impact by chance, we will follow IES guidelines (See NCEE- 2008-4081) by pre-specifying a small number of primary – confirmatory – research questions and by conducting a composite statistical test to "qualify" or call into question multiple hypothesis tests that are statistically significant individually but that may be due to chance in the context of mixed results. The main **confirmatory** research question guiding the study design is: ***What is the impact of STAD-Math on middle school students' math achievement, compared to students in non-STAD-Math classrooms?***

In addition to the main confirmatory question, this evaluation will address **exploratory questions** intended to deepen our understanding of the overall average impact of SFA:

1. ***Subgroup impacts (experimental)***: How do impacts of STAD-Math differ for students at high, average, and low levels of math pretest scores? For students of low socio-economic status? For students with disabilities? For limited English proficient student? For students of various ethnic backgrounds? For boys and girls?
2. ***Impacts on non-cognitive outcomes (experimental):*** What is the impact of STAD-Math on measures of attendance, special education assignments, and retention?

3. ***Dosage (non-experimental):*** Does STAD-Math produce greater impacts for students who receive a greater amount of SFA services: that is, a ―stable sample" of students who remain in the STAD-Math schools over several years?
4. ***Program Implementation (correlational):*** Are impacts on math achievement higher in districts with stronger implementation of the STAD-Math treatment?

Site Recruitment and Random Assignment. During the 2012-13 school year, districts will be recruited for the study cohort. Within each district, we will offer eligible middle schools an opportunity to participate in SFA at no cost for staff training or instructional materials. School math teachers will receive information about STAD-Math and will vote to participate in the study. Only schools in which 75% of teachers vote in favor of participating will be included. Schools will be randomly assigned to either the STAD-Math treatment or the control condition. To gain their cooperation for the study and data collection activities, the control schools will be offered payments of up to $5,000 to compensate them for the burden of data collection and placed on a priority list for STAD-Math implementation following completion of the study.

Student Study Sample. Fall 2013 sixth graders in the randomly assigned schools will comprise the student study sample. Assuming an average of 200 sixth graders per school, this will result in a total baseline study population of about 8,000 children (4,000 in the STAD-Math schools and 4,000 in the control schools). These students will be followed for three years, through the end of the 2015-16 school year, when they will reach eighth grade. Because the analysis focuses on the schools in the sample, we will not follow students who move away from their original study school, but will include ―in movers" who join the target grades over time. We will collect annual data on the composition of students in both the treatment and control schools to check for any unexpected effects on student mobility and, if there are none, we will

also be able to examine impacts for a ―stable sample" of students who remain in the STAD-Math and control schools over time.

Key Outcome Measures. The primary student outcome is students' achievement in mathematics. We will use two types of baseline math test scores in the analysis as covariates: 5th grade state math test scores for 6th graders in the sample and prior year 6th grade test scores on the state math test for each school in the sample. As our measure of math achievement at the end of the first and second year, we will assess state math test scores for 6th graders tested in the spring of 2014 and 7th graders tested in the spring of 2015 in each study school. In the spring of 2016, we will field a group-administered follow-up tests for all 8th graders in the study schools, usual the Stanford Diagnostic Math Test (SDMT) or a similar test. Given the uncertainty site configuration in the study sample at this point, we are unsure exactly how much additional special evaluation testing we will be able to field. We have included funds in the budget that we expect will allow us also to field the SDMT for 7th graders in the spring of 2015 or for 6th and 7th graders in the spring of 2016. Each wave of testing will be completed within a 4-5 week window to reduce growth-related differences, and the treatment-control schools within districts will be tested concurrently to reduce the possible introduction of bias from test timing differences.

Because of the policy importance of state assessments and the lower cost of using existing state test scores, we have a research plan that calls for obtaining state math test data for students as the primary math outcome in years when evaluation testing is not undertaken or as a an exploratory ***sensitivity test*** of the confirmatory findings when the evaluation testing does occur. To deal with the variation in tests across states we will place the different tests on the same metric by converting them to z scores, as suggested by May (2009). In addition, we will collect attendance rates, special education assignment rates, and retention rates from school

records for individual students, which will allow us to estimate impacts on these exploratory outcomes for students at all grade levels in the study.

Impact Analysis. Our basic impact estimate will be a two-level HLM model with students nested in schools. Blocking will account for any stratification in the school lotteries should districts request this. Covariates in the impact model will include key student characteristics such as percentages of ELL, special education, and free/reduced price lunch students, and baseline student math achievement test scores (both 5th grade tests for students entering the sample as 6th graders and prior 6th grade tests in each school. This model will provide an intent-to-treat estimate of providing access to the intervention on students in the average school in the sample.

Power analysis. We estimate minimum detectable effect sizes (the smallest true effect that can be detected for a specified level of power and significance level for any given sample size) of .15 for mathematics achievement test scores for students. These calculations are based on a sample of 40 schools split evenly between treatment and control, 200 students per grade per school, with 85% response rate at student level, 80 percent power, a statistical significance level of .05 with a two-tailed test, and between-school variation in test scores of 0.17, and covariates explain 96 percent of between-school variation and 55 percent of within-school variation. Analysis of student subgroups constituting approximately half the sample (100 students per grade per school) would have MDESs of approximately .20 for mathematics outcomes. All these MDESs are below the lower limits of the confidence interval for STAD-Math effects derived from a meta-analysis of rigorous studies.

Exploratory Analyses. As mentioned above, our analysis of exploratory questions will be conducted to interpret the finding on the confirmatory research question. We will use the

same impact model in estimating impacts on other outcomes and for other groups. However, we will present these findings to help readers understand the source of findings on the confirmatory question and as a source of hypotheses about explanations.

(2) THE EXTENT TO WHICH THE METHODS OF EVALUATION WILL PROVIDE HIGH-QUALITY IMPLEMENTATION DATA AND PERFORMANCE FEEDBACK, AND PERMIT PERIODIC ASSESSMENT OF PROGRESS TOWARD ACHIEVING INTENDED OUTCOMES.

Our planned evaluation will address five key topics related to the implementation of STAD-Math in the study schools: (1) How did STAD-math staff work with schools to implement the STAD program? (2) What resources, training, materials, and ongoing technical assistance were needed? (3) Was the STAD-Math model implemented with reasonable fidelity in the study schools? (4) What was the contrast in the education experience, especially related to math instruction, between the STAD-math schools and the control schools? and (5)What are the implementation lessons both as the study unfolds and for future replication efforts? Our analysis will draw on information collected through four methods, as discussed below in order of the key topics listed above.

STAD-Math Implementation Experience. Our analysis will rest on structured interviews and brief surveys with STAD-Math staff and school administrators and teachers. Experienced MDRC qualitative researchers will visit all program schools (and, as discussed below) more briefly visit control schools in the spring of 2014 and 2015. During the visits to the program schools, they will interview the principal and teachers providing math instruction to understand their perspectives on STAD-Math and its implementation, the support they received, challenges that arose, and responses that were developed to address them. In addition, a teacher survey will be the source of information about teachers' background and experience, knowledge

of mathematics instruction, relationships with students, and perceptions of the school environment. MDRC staff will administer the surveys at the STAD-Math schools during the course of site visits conducted during spring 14 and 2015 school years and study-funded data collection liaisons in the control schools will facilitate fielding the teacher surveys. These data, in conjunction with the School Achievement Snapshots, discussed below, will provide valuable insights into the conditions under which effective and faithful implementation of the program model is most likely to occur.

Fidelity of Implementation. STAD-Math is a complex program which has developed detailed rubrics, known as the School Achievement Snapshot, that trained SFAF coaches use in the course of regular site visits to rate each school on the extent to which it has implemented the key structures and instructional processes associated with the program and to guide ongoing technical assistance efforts. Given the extensive knowledge of STAD-Math needed to rate its fidelity and the investment SFA has made in the design and fielding of the Snapshot, MDRC intends to capitalize on this instrument to develop measures of the extent to which the 20 program schools exhibit fidelity to the STAD model. MDRC staff will then use these data for each of the three school years included in the study to identify key constructs that summarize the extent to which key elements of STAD-Math are implemented with fidelity in the treatment schools. This strategy will provide much more reliable measures of fidelity than any effort by evaluators to rate program services.

Service Contrast between STAD-Math and Control Schools. The service contrast produced by implementing STAD-Math is the driver of observed impacts on student outcomes, so it is important to measure the extent and dimensions of the service difference between the STAD-Math and control schools. In our field research, we will interview control school

administrators to learn about improvement efforts. As a quantitative measure of the key service contrast related to reading and literacy instruction, we will field in both STAD-Math and control schools an adaptation of the teacher instructional logs developed by Brian Rowan and his colleagues at the University of Michigan for the Study of Instructional Improvement. The log is a close-ended instrument that has been shown in prior research to differentiate effectively between instruction in treatment schools, schools that adopted other programs, and schools where no special intervention was in place. We plan to collect logs from each math teacher in each of the 40 study schools in the winter and spring of 2014 and 2015, with an expected sample of approximately 24 logs per school for each school each year, which is sufficient to identity differences in instruction between the two groups of schools.

*(3) **THE EXTENT TO WHICH THE EVALUATION WILL PROVIDE SUFFICIENT INFORMATION ABOUT THE KEY ELEMENTS AND APPROACH OF THE PROJECT SO AS TO FACILITATE REPLICATION OR TESTING IN OTHER SETTINGS.***

The data described above will also allow us to describe in project reports the effort needed to implement the intervention and the lessons learned for successful operation. The study will be conducted in diverse contexts under conditions similar to those in which scale-up efforts will be conducted, so the findings of the evaluation will be based on a design that has both strong internal validity and strong external validity. We will be able to document the nature of the services provided, the staffing arrangements, types of training provided staff, and the challenges encountered in implementation and promising responses. At the end of each of the three study years, we will produce an concise, annual interim report that will provide both periodic updates on fielding of the evaluation, assessments of STAD-Math program implementation and the contrast with instruction in the control schools, and information on the impacts of STAD-Math

on student's math achievement and other outcomes as data becomes available. These will be relatively short reports intended to examine the extent to which progress is being made. The final summative evaluation report will report all of the annual impact estimates, as well as the planned sensitivity and exploratory analyses, the analysis of the treatment fidelity data, and the longitudinal treatment-control instructional contrasts.

(4) THE EXTENT TO WHICH THE PROPOSED PROJECT PLAN INCLUDES SUFFICIENT RESOURCES TO CARRY OUT THE PROJECT EVALUATION EFFECTIVELY.

Our evaluation budget of approximately $3.9 million, plus extensive support for schools randomly assigned to implement STAD-Math, will allow us to conduct a high quality, rigorous study and share findings widely. Because the program will be offered to schools free of charge, recruitment should be relatively easy, and we can insist on clear buy-in from prospective schools and on their full participation in the evaluation, either as STAD-Math or as control schools. For measuring program impacts, we have budgeted for fielding our own achievement measures to a considerable extent and can rely on extent student math test data when testing is not feasible given resource constraints. Resources for STAD-Math training and coaching will be the same in the evaluation program schools as those used in all STAD-Math schools, allowing us to study STAD-Math as it is being more broadly scaled up under i3.

The evaluation team is also qualified to undertake this work. In its 35-year history, **MDRC** has earned a reputation as a trusted and authoritative source of information about what works and what doesn't work in education and social policy. MDRC is known for the rigor of its research and for its commitment to building evidence and improving practice in partnership with school districts, community colleges, state and local governments, and community-based organizations. Working in fields where emotion and ideology often dominate public debates,

MDRC is a source of objective and unbiased evidence about cost-effective solutions that can be replicated and expanded to scale. With staff of more than 200 in New York and California, MDRC is engaged in close to 80 projects in five policy areas. At a time of growing national and state interest in improving low-performing schools and better preparing students for college and work, a commitment to rigorous evaluations and demonstration programs has established MDRC as a respected voice in education research and policy. To date, MDRC has managed 20 major education studies representing a range of both structural and instructional reforms at both the secondary school and elementary school levels.

Required Evaluator Collaboration and Dissemination. The evaluation team will comply with the requirements of any program evaluation conducted by ED, participate in pertinent "Communities of Practice" activities, and accept technical assistance provided by the Department. The evaluation team will seek out venues for the dissemination of study findings both at the end of the annual impact assessments and at the end of the entire study. These will include presentations at professional conferences and meetings, and submissions to peer-reviewed journals. Finally, we will prepare a restricted use file that will be made available to other researchers who can conduct further analysis to verify and extend the findings.

D. QUALITY OF THE MANAGEMENT PLAN AND PERSONNEL

(1) THE ADEQUACY OF THE MANAGEMENT PLAN TO ACHIEVE THE OBJECTIVES OF THE PROPOSED PROJECT ON TIME AND WITHIN BUDGET, INCLUDING CLEARLY DEFINED RESPONSIBILITIES, TIMELINES, AND MILESTONES FOR ACCOMPLISHING PROJECT TASKS, AS WELL AS TASKS RELATED TO THE SUSTAINABILITY AND SCALABILITY OF THE PROPOSED PROJECT.

Management Plan. The project will be managed in partnership between Old Dominion University (ODU), high-need LEAs, Johns Hopkins University, and the Success for All Foundation (SFAF). Please see **Appendix J.** for a complete **Timeline of Management Plan Objectives, Activities, Responsible Parties and Milestones by Year.** Each partner district will hire one or more persons to serve as local coaches for STAD-Math, and SFA and CTE will provide extensive training and technology supported follow-up and tools to ensure that these school-based coaches are fully prepared to provide outstanding services to their schools. Coordination between STAD-Math school coaches and their SFA supports will be critical to the success of this initiative. We will have regular, technology-facilitated meetings of school-based coaches and their SFAF counterparts approximately 6 times each year for teaching video-analysis and video-consultations on teaching practices, 3 times per year for video-coaching analysis and video-consultations on coaching practice. The initial pilot group of coaches will be trained in 2012-2013 with the STAD-Math coaching curriculum, including training in each program component, goal-focused continuous improvement strategies, and coaching approaches. Each school-based coach will be assigned to a regional STAD-Math facilitator that will serve as a mentor. District partner coaches will participate in on-line learning communities of STAD-Math coaches, whose members will support them in reflection on their practice as coaches, share solutions to problems, and discuss common challenges. In addition, electronic communications including email, webcasts, webinars, and conference calls, will be used to connect district-based coaches with SFA coaches.

ODU and SFAF leaders will maintain regular contact with district leaders, such as superintendents, directors of secondary mathematics, and principals. ODU and SFA staff will meet regularly on site with these leaders, to review outcome and implementation data and plan

for goal-focused continuous improvement. We will also meet with district leaders and coaches as a group at our annual experienced sites conferences. District leaders, district coaches, and ODU and SFA staff will jointly agree on annual objectives in terms of amounts and quality of coaching, program adoption, and student outcomes. We will then jointly develop a goal-focused plan and monitor progress toward agreed-upon goals, recommending changes intended to improve outcomes.

ODU and SFA staff will also coordinate with "other partners," such as state departments of education and intermediate units. Memoranda of Understanding will be negotiated individually with all partners to specify precisely what each is expected to do and to agree to time scales.

Scale-up dissemination activities. We will disseminate information on the project through a variety of outlets in order to ensure the development of partnerships with high-need schools during and after the project period. First, we will purchase advertising space in popular magazines, such as *Educational Leadership* and *Education Week*, and in on-line outlets such as the *ASCD SmartBrief* and *Google Adwords*. We will attempt to take advantage of free media by talking with journalists, bloggers, and others about newsworthy developments with STAD-Math and the scale-up project, especially research findings. We will purchase booth space at major national conferences, such as Title I, ASCD, AASA, NASSP, and NAFEPA, and local conferences in areas where our district partners are located. We will hold local demonstrations to invite principals and teachers to visit existing STAD schools, speak with their counterparts, and form their own opinions. Our district partners and state department of education partners in several states will disseminate information about STAD-Math through state superintendents'

associations. We will work through state school improvement directors to encourage districts and coalitions of schools to become additional partners over time.

Sustainability . After the i3 grant period is over, we are confident that the gains we expect to make in numbers of schools making effective use of STAD-Math will be sustained, and that our network will continue to grow. The scale-up project will invest in infrastructure, particularly district-based coaches responsible for schools in their areas, as well as the development of materials and procedures to support high-quality, cost-effective implementations of STAD-Math in the new, locally-focused scale-up strategy. We expect most or all districts to maintain these trainers at the end of the project with their own Title I resources, because as long as the districts continue to implement STAD-Math, a local coach will always be their most cost-effective means of providing high-quality coaching. These coaches will already be trained and fully capable. If districts do continue to support their coaches, the scale-up strategy can continue indefinitely after project funding has ended. In situations in which they do not, the Success for All Foundation will, wherever possible, locate trainers in the local area. In either case, the schools that have adopted STAD-Math will, based on our past experience, be likely to continue to use it for many years without additional grant funding beyond ordinary Title I funding, ensuring that the investment made by i3 in the scaling up of STAD-Math will continue to benefit hundreds of thousands of students.

Partnerships with state departments of education, intermediate units, and other cross-district organizations, will also contribute to the sustainability of scale-up. State departments are charged with helping schools and districts meet national standards under ESEA. If they have good experiences with STAD-Math in their struggling schools, they are likely to continue to support schools and districts in adopting and maintaining the program. State departments and

intermediate units, such as regional educational cooperatives, are particularly important in rural schools, which are less likely to have extensive professional development resources in their own districts.

(2) THE QUALIFICATIONS, INCLUDING RELEVANT TRAINING AND EXPERIENCE, OF THE PROJECT DIRECTOR AND KEY PROJECT PERSONNEL, ESPECIALLY IN MANAGING LARGE, COMPLEX, AND RAPIDLY GROWING PROJECTS.

The proposed staff of the STAD-Math scale-up project have been working for many years on development, evaluation, dissemination, and scale-up of complex school and classroom reforms. We have designed and carried out many large-scale randomized and quasi-experimental evaluations. Our school district partners also have extensive experience in educational innovation, management, and reform. Our qualifications and roles in the project are as follows.

John Nunnery (ODU), Project Director, is the Executive Director of The Center for Educational Partnerships at Old Dominion University and Associate Professor of Educational Leadership and Foundations. He previously served as Director of the Bureau of Educational Research at The University of Memphis, Associate Research Scientist at Johns Hopkins University, and Executive Director of Research, Standards, and Accountability for the Memphis City Schools, where he was budget unit director for four units employing over 200 professional employees with an annual budget exceeding $12 million. During his tenure with Memphis City Schools, the system won the Broad Prize and National Superintendent of the Year for large-scale school restructuring involving over 160 high-poverty schools, and his division won the first "Best Practices in Accountability Systems" award from the American Productivity and Quality Center for innovations in strategic planning, school improvement planning, organizational efficiency, and performance evaluation. His research and leadership interests are focused on

providing effective solutions for educators of students at risk of failure due to economic hardship or historical deprivation. His work has been cited as meeting the highest standards of rigor by the National Clearinghouse for Comprehensive School Reform, the Comprehensive School Reform Quality Center, and the Education Commission of the States. Dr. Nunnery received a Pew Charitable Trusts National Teaching Leadership award in 1991, the Charles E. Clear Award for consistent and substantial contributions to educational research in 2007, and the Sara and Rufus Tonelson Award for outstanding contributions in teaching, research, publication and service in 2009. Dr. Nunnery will direct the project, including overall fiscal management and strategic planning, collaborating with co-project director Dr. Madden to ensure effective and timely delivery of materials and professional development support to schools, overall management of the Systems Redesign Workgroup, interfacing with the external evaluator, management and coordination of the activities of all ODU staff on the project, and developing and managing subcontracts for all LEA and other official partners.

Gary R. Morrison (ODU) received his doctorate in Instructional Systems Technology from Indiana University and is a professor and graduate program director in the instructional design and technology program at Old Dominion University. His research focuses on cognitive load theory, instructional strategies, K-12 technology integration, and distance education. He is author of two books: Morrison, Ross, & Kemp's *Designing Effective Instruction* (6th Edition) and Morrison & Lowther's *Integrating Computer Technology into the Classroom* (4th Edition). He has written over 25 book chapters and over 40 articles on instructional design and educational technology. Gary is the editor of the *Journal of Computing in Higher Education* and is on the editorial boards of *Computers in Human Behavior, Quarterly Review of Distance Education,* and Libraries Unlimited's *Instructional Technology Series*. He has worked as instructional designer

for three Fortune 500 companies and the University of Mid-America. Two of the distance education courses he designed were accepted for broadcast on PBS and NPR. Dr. Morrison will co-chair the Systems Redesign Workgroup and co-lead the mixed-methods synthesis of systems redesign data along with Dr. Bol.

Linda Bol is a Professor of Educational Psychology and Research at Old Dominion University. She received her Ph.D. in Educational Psychology from the University of California-Berkeley in 1993, where she won the dissertation of the year award for research on how science teachers' assessment practices impact student self-regulation and learning of science content. Since that time, she has published dozens of articles in high impact journals, such as the *Journal of Educational Psychology*, the *Journal of Experimental Education*, and the *Journal of Educational Research*, and currently is on the Editorial Board of the *Journal of Educational Psychology*. In addition to her work on student self-regulation, she has conducted and published research on supports and impediments to teacher implementation of educational reforms in high needs schools, cooperative learning and math achievement in secondary schools, and professional development supports for teacher learning. Dr. Bol will co-lead the mixed-methods synthesis of systems redesign data along with Dr. Morrison.

Jacqueline Nunn (JHU-CTE) has been director of CTE for nearly two decades and has been instrumental in advancing the Center's efforts in all of its core areas—early childhood initiatives, emerging technologies, and online learning. She is Associate Dean for Educational Technology in the JHU School of Education. Dr. Nunn has been the principal investigator or co-investigator on numerous federal and state grants, including Technology Innovation Challenge, Star Schools, Preparing Tomorrow's Teachers to Use Technology, and OSEP Stepping Stones grants. Before becoming the director of CTE, Dr. Nunn worked as a teacher, special educator,

principal, and school district administrator. As a district administrator, she directed all preschool special education services in Fairfax County, VA. Dr. Nunn will lead the initial technology development and deployment, and will co-chair the Systems Redesign Workgroup.

Robert E. Slavin, is Chairman of the Success for All Foundation, Director of the Center for Research and Reform in Education (CRRE) at Johns Hopkins University, and Director of the Institute for Effective Education at the University of York. Dr. Slavin has authored or co-authored more than 200 articles and 15 books. He received the American Educational Research Association's Raymond B. Cattell Early Career award for Programmatic Research in 1986, the Palmer O. Johnson award for the best article in an AERA journal in 1988, the Charles A. Dana award in 1994, the James Bryant Conant award from the Education Commission of the States in 1998, the Outstanding Educator award from the Horace Mann League in 1999, and was named a Fellow of the American Educational Research Association in 2010. Dr. Slavin is a world-renowned educational scholar and reformer, known as the father of cooperative learning for his ground-breaking research and reform efforts that have reached over 2,000,000 children worldwide.

Nancy A. Madden is the President and CEO of the Success for All Foundation, which provides the training and implementation support for over 1000 Success for All schools Dr. Madden has been President of the Foundation since it was established in 1997. Dr. Madden is also a professor at Johns Hopkins University and the University of York's Institute for Effective Education in the UK. Dr. Madden will be responsible for overseeing the provision of all aspects of implementation support for schools in the study and recruitment of new schools.

Dr. Fred Doolittle (external evaluator) is Vice President and Director of MDRC's K-12 Education Policy Area. Dr. Doolittle has focused on implementation and impact evaluations of

programs for low-income children and youth. When he joined MDRC in 1986, he led evaluations employment programs for youth who have dropped out of high school. Starting in the mid-1990s, he began working on evaluations of elementary and secondary school reforms. He has served as leader or senior reviewer of more than 20 national, multi-site randomized field trials and other evaluations at MDRC. Recently, Dr. Doolittle completed three IES projects on which he served as project director or co-director: IES's evaluations of Reading Professional Development Evaluation, Math Professional Development, and Enhanced Academic Instruction in After-School Programs, which were randomized control trials. He is currently leading the Impact Evaluation of Response to Intervention in Early Reading, which will involve non-experimental methods, an i3 scale up evaluation of Success for All, and a Social Innovation Fund evaluation of the BELL Summer Program. The author of many publications, Dr. Doolittle is heavily involved in developing and reviewing research designs for projects, and reviewing reports and other products. He has served on the faculty of the Summer Institute of Education Sciences Training on Randomized Clinical Trials and is an advisor to grantees of the W.T. Grant Foundation on research design and implementation. Prior to joining MDRC, Doolittle was on the faculty of the Kennedy School of Government at Harvard, where he taught graduate public policy analysis and during his tenure at MDRC he has taught program evaluation at the Yale School of Management. He holds a law degree and Ph.D. in economics from the University of California- Berkeley.

Pei Zhu, MDRC Senior Associate, K - 12 Education Policy Area. Dr. Zhu is an economist in MDRC's K-12 Education policy area whose current work focuses on experimental and quasi-experimental impact analyses, evaluation design, and related methodological issues. She is leading the student achievement impact analysis for several federally funded group-level

randomized experiment projects, including evaluations of professional development programs for second-grade reading teachers and seventh-grade math teachers, as well as the evaluation of the Response to Intervention program for struggling readers in early elementary grades. She has worked on the impact analysis on student outcomes in the National Reading First Impact Study and the evaluation of enhanced academic instruction in after-school programs for second- through fifth-graders. Her work at MDRC includes several methodological studies on empirical issues related to group randomized experiments and on reliability of measurements for group settings. She received her Ph.D. in economics from Princeton University.

(3) THE ELIGIBLE APPLICANT'S CAPACITY (E.G., IN TERMS OF QUALIFIED PERSONNEL, FINANCIAL RESOURCES, OR MANAGEMENT CAPACITY) TO BRING THE PROPOSED PROJECT TO SCALE ON A NATIONAL, REGIONAL, OR STATE LEVEL WORKING DIRECTLY, OR THROUGH PARTNERS, EITHER DURING OR FOLLOWING THE END OF THE GRANT PERIOD.

Housed along with the Old Dominion University Research Foundation (ODURF) in Innovation Research Park, the Center for Educational Partnerships of the Darden College of Education at Old Dominion University has permanent staff consisting of four Ph.D. level research scientists, an Executive Director, an Executive Secretary, 5 graduate research assistants, and a fiscal technician, and draws on the capacity and expertise of more than 100 Ph.D. faculty in the Darden College of Education; the research, development, and dissemination support provided by the ODU Office of Research; and the grants/contracts administration capabilities of ODURF. In FY 2010, ODURF administered over $60 million in research and development expenditures, including more than $14 million in educational R&D. ODURF has 34 staff and provides information technology, accounting and procurement, grants and contracts

administration, human resources administration, and intellectual property management support to TCEP.

The National Science Foundation recently ranked the Darden College of Education at Old Dominion University as 16th in the United States in educational research and development expenditures, much of which is devoted to STEM education and to partnerships with schools across the country to provide research-based professional development and initial training and licensure of teachers and school leaders. The mission of The Center for Educational Partnerships (TCEP) at Old Dominion University is to develop partnerships with providers of research-based, proven educational models and high need LEAs, and we currently provide professional development for LEA leaders in every school division in Virginia, and have direct partnerships focused on school improvement with 14 school divisions. Based on our ongoing work with the Virginia Department of Education and our LEA partners, we have identified middle school math achievement as one of the top three priorities for school improvement in the state. Twenty-two rural school divisions in Virginia have already indicated a desire to be included in the study or scale-up phases of this project. Thus, we are confident that by working through our partner The Success for All Foundation (SFAF) we have the capacity and goodwill to bring the proposed project to scale both in Virginia and on a national level.

SFAF has an exceptional record in carrying out projects of the size and scope of this one, and achieving positive student outcomes in urban and rural schools serving many children in poverty. SFAF has a total staff of 220, of whom about 120 are coaches located in various parts of the US and 100 are developers, researchers, and experts on finance, human resources, marketing, information technology, and so on. The total annual budget of SFAF is about $40 million, and comes mostly from fees for service and materials that schools usually pay from their Title I

budgets. SFAF also receives grants to develop and evaluate new programs, usually from the U.S. Department of Education. SFAF's headquarters in Baltimore houses the Foundation's executive management as well as administrative functions including Contracts, Accounting, Outreach, Information Systems, Human Resources, and Customer Service. The facility also contains SFAF's curriculum development groups, research staff, and several trainer support functions, including conferences, training materials, and the training institute. State-of-the-art computers and communications systems, with technical support staff, will be available for the project.

With a professional development and coaching staff of approximately 120, SFAF has the resources to support principals, teachers, assistants, and central administrators. Currently, Success for All schools are located in more than 400 school districts in 48 states throughout the US. SFAF also has a staff of about 40 program developers working in reading, writing, math, social studies, and science, in grades prekindergarten to 10. SFAF has an award-winning video production team that is experienced in creating television-quality content cost effectively. In addition to a producer, assistant producer, and support staff, SFAF regularly uses studios, actors, and other contractors to create educational videos. SFAF has the publications and distribution capabilities to provide the curricular materials necessary to implement innovative programs. There is a staff of 22 publications professionals who do project management, artwork, design and layout, printing, and inventory control.

The Center for Technology in Education (CTE) at Johns Hopkins University is a unique partnership between the Maryland State Department of Education (MSDE) and Johns Hopkins University. Since 1991, CTE has applied its expertise in five critical areas: data-driven decision-making, evidence-based instruction, assistive technology, standards-based assessment and mentoring, and online learning and communities of practice. CTE's work includes a wide

array of programs, projects, and research activities designed to increase the capabilities of teachers, parents, schools, and communities, ultimately improving educational outcomes for all children. CTE is comprised of 29 full time faculty and staff, many of whom are former teachers and school administrators. As a unit of Johns Hopkins, CTE benefits from the infrastructure, facilities, faculty resources, and administrative personnel of the wider university. Its offices are housed in a JHU satellite campus in Columbia, Maryland, centrally located between Baltimore and Washington, DC. CTE has 14 years of experience creating software-based tools for educators. Products that have been developed and licensed by the JHU Office of Technology Transfer include systems for a) online learning and collaboration, b) digital portfolio development, c) data collection, reporting and decision support, and d) classroom teacher observation. CTE's iterative development process includes requirements gathering with stakeholder participation, a detailed wire-frame functional analysis, visual design prototyping, and a rigorous testing and quality assurance process. The online learning platform created by CTE, which will form the backbone of the project's online learning community, has been used by more than 15,000 educators across 50 educational organizations since 2001.