Scalability, Capacity, and Learning Engagement for Underserved Populations (SCALE UP) for *Fraction Face-Off* (*Absolute Priority 1* and *Absolute Priority 3*)

A. Significance

(1) National Significance of the Proposed Project

In this project, we address *Absolute Priority 1* by implementing at a national level an efficacious mathematics intervention that has strong evidence of effectiveness. We target *Absolute Priority 3* by elevating and strengthening the educators who provide supplemental instructional support for students experiencing difficulty in mathematics (subsequently referred to as **students with MD**). We seek to support *Competitive Preference Priority 1* by collaborating with 4 partner universities that are identified as minority-serving institutions. Finally, we focus on *Competitive Preference Priority 2* by implementing an evidence-based instructional approach in mathematics (abbreviated as "math") to address the ongoing impact of the COVID-19 pandemic. The purpose of this proposal is to examine whether positive impacts can be successfully reproduced and sustained over time in 2 novel settings – rural schools and out-of-school (OOS) settings. We seek to understand the conditions under which the program is most effective at improving student outcomes. Although we do not meet the criteria for Rural Eligibility, please note that we exclusively focus on supporting students with MD in rural schools in Years 1-3.

In this project, we build on our mid-phase EIR-funded project, Scalability, Capacity, and Learning Engagement (SCALE) for Fraction Face-Off to Accelerate Mathematics Learning of Students Experiencing Mathematics Difficulty (2021-26; S411B210032). We completed two years of implementation in which we replicated *FFO* in diverse settings with school-based interventionists. We worked with about 110 interventionists and more than 500 Grade 4 students with MD. As a strategy to scale, we developed virtual training on *FFO* implementation (which will be used in the proposed project to train *FFO* interventionists). Results from Year 1, as reported below, replicate similar positive student outcomes as the original developers of *FFO*, and provide evidence that our proposed Expansion Phase project is viable and may contribute strong evidence about the positive impacts of *FFO*.

Students and schools are differentially recovering from interruptions in learning caused

by the COVID-19 pandemic. Recent data suggest that progress toward pandemic recovery in math has stalled, especially for underserved populations (Lewis & Kuhfeld, 2023), including students with MD. Performance on the 2022 math National Assessment of Educational Progress (NAEP; NCES, 2023) at Grade 4 indicated that only 15% of students with disabilities scored at or above proficient compared to 39% of students without disabilities. The gap in performance between high- and low-poverty schools widened in 2022-23 (Fahle et al., 2024). It is important to note that these data do not address pre-pandemic discrepancies in outcomes for underserved populations; instead, these discrepancies have been exacerbated. Moreover, different communities are rebounding differentially. Data indicate that students living in suburban locales performed significantly higher than students living in rural and urban locales (NCES, 2023).

Rural schools face unique challenges supporting students with MD. About 1.1 million (15%) students with disabilities attend rural schools. Staffing shortages as well as limited time and resources are often barriers for educators in rural schools to provide intervention (Ruecker, 2021). Staffing constraints are often a challenge in rural schools; in 2022, 36% of rural schools had at least one teaching vacancy (Cai, 2023). Rural school leaders report hiring educators that are not fully qualified, and a majority report that they would have reservations about firing a low-performing educator due to difficulties finding a replacement (Showalter et al., 2023). Educators in rural schools often experience unique barriers to accessing professional learning (PL) such as traveling distances, finding substitute coverage for their classes, and arranging child care (Berry et al., 2011). These point to a critical need in rural schools for access to efficacious interventions and PL opportunities to support educator and student outcomes.

Students need more time learning high-priority content. To catch up to pre-pandemic levels of math outcomes, students will need an average of 4.5 additional months of schooling. One way to provide this additional instruction is to provide students access to high-dosage tutoring with efficacious interventions. But now that federal and state financial support for pandemic recovery has ended, many schools do not have resources to provide this additional tutoring. Studies have shown multiple benefits for students in OOS tutoring, but only if they are

involved in high-quality and high-dosage tutoring (Vandell et al., 2020). Most OOS settings are typically staffed with personnel who are not credentialled educators, and programs with underqualified individuals do not lead to better student outcomes (Lester et al., 2020).

Fractions are important. Fractions are described as the most complex math before secondary school and an essential gatekeeper to success with algebra (Booth & Newton, 2012). While initial understanding of fractions begins in the early elementary grades with dividing shapes into equal parts, fractions are formally introduced in Grade 3 when students learn about a whole partitioned into equal parts and a fraction as a number on the number line. Developing understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers usually occurs in Grade 4.

Many students experience difficulty with fractions, particularly students with a disability (Hansen et al., 2017). This is a critical issue given that fractions serve as one of the foundations for algebra and are a significant predictor of later math performance (Siegler et al., 2012). Fraction knowledge is important for STEM careers, but fraction knowledge is also needed for many non-STEM jobs as well as for everyday activities. Given the importance of fractions, it is necessary to implement targeted intervention about fractions (Jordan et al., 2024). A substantial body of research over the past 30 years documents elements of effective math instruction for students with MD (Fuchs et al., 2021). Consistently, explicit and systematic instruction has been shown to produce positive effect sizes for a variety of outcomes including fractions, especially when combined with visual representations (often with concrete and pictorial representations).

(2) Potential Contribution to Increase Knowledge of Effective Strategies

We address students' difficulty with fractions by implementing at a national level an efficacious math intervention that has strong evidence of effectiveness: *Fraction Face-Off* (abbreviated as *FFO;* Fuchs et al., 2013); this aligns with *Absolute Priority 1* and *Competitive Preference Priority 2*. We extend our current mid-phase EIR-funded project, Project SCALE (S411B210032) and contribute rigorous evidence of effectiveness with new populations in two new settings – rural schools and OOS settings. We address the unique needs of these settings by

studying the impact of PL and coaching to support effective implementation with fidelity.

Fraction Face Off is an efficacious Tier 2 intervention, designed by Fuchs, Schumacher, and colleagues, to support students with MD in Grade 4. Evidence of effectiveness meets WWC design standards without reservations with a Tier 1 Strong classification across 7 math outcomes of interest (Fuchs et a., 2013; WWC, 2020). Moreover, *FFO* was designed based on evidence-based practices to support students with MD and aligns with the IES Practice Guide (Fuchs et al., 2021). It is important to note that the research team ([redacted]) did not develop *FFO*, and we have no financial interest in *FFO*.

FFO incorporates explicit instruction to represent fractions with part-whole and measurement interpretations. Both interpretations are essential for fraction competence (Schumacher et al., 2018). *FFO* consists of 36 sessions divided into a 12-week implementation schedule, with 3 sessions per week, each lasting about 30-35 min. The lesson guides are written with explicit instruction and use clear and concise explanatory language. Each *FFO* session consists of 5 activities. During (1) Training, educators model the new content with concrete manipulatives and work examples to demonstrate how to solve different fraction problems. During the (2) Relay, students take turns solving fraction problems and applying learned concepts taught during the Training activity. During (3) Fraction Sprint, students build fluency with fraction magnitude and equivalency through three different flashcard activities. With (4) Individual Contest, students work individually to check their understanding of the fraction concepts. The educator scores the students' work and provides important corrective feedback. During (5) Scoreboard, the educator tells the group how much of the fraction currency they earned during the day's lesson.

There is strong evidence to support *FFO*. As identified by the WWC, *FFO* has Tier 1 Strong evidence on 7 outcomes related to math or fractions for Grade 4 students with MD. In Fuchs et al. (2013), the original *FFO* study, the authors noted ESs favoring *FFO* students ranging from 0.91-2.50. Fuchs et al. (2014) identified ESs for *FFO* ranging from 0.80-1.13 for proximal measures and 0.60-0.63 for NAEP-released fraction items. Fuchs et al. (2015)

suggested ESs for *FFO* as 1.54-1.89 for a similar sample of students. Fuchs, Malone, et al. (2016) identified ESs favoring *FFO* in the range of 0.57-2.08. Fuchs, Schumacher, et al. (2016) help improved the fraction knowledge of students with ESs of 0.81-1.70 on proximal measures and 0.33-0.44 on NAEP-released fraction items. Finally, Malone et al. (2017) identified ESs from 0.36-3.14). In our mid-phase EIR project focused on use of *FFO* at Grade 4, with a sample of students with MD in 2 states, we noted ESs favoring *FFO* students on measures of Fraction Arithmetic (ES = 1.06), Fraction Comparison (ES = 0.26), and Fraction Ordering (ES = 0.25).

In this Expansion project, we address *Absolute Priority 1* and *Competitive Preference Priority 2* by examine whether the observed positive impacts can be successfully reproduced and sustained over time in two novel settings – rural schools and OOS settings. First, we propose to conduct an efficacy trial with students with MD in Grades 4-5 in rural schools at a national level. We work with educators (subsequently referred to as **interventionists**) who provide intervention to students experiencing MD. We build on models of effective educator learning to design and test online PL and coaching with rural interventionists. We conduct exploratory analyses to examine the impact of different school-based approaches to screening students for intervention on the treatment effects. We also explore the impact of technology-assisted fidelity of implementation observations on treatment effects. Second, we propose to conduct an efficacy trial with students in Grades 4-5 in OOS settings. We work with service providers, who serve as interventionists, and examine the effectiveness of PL and coaching with OOS interventionists.

To address *Absolute Priority 3*, we focus on elevating and strengthening the educators who support students with MD. A primary approach for improving student academic outcomes is through providing PL to educators. PL includes the formal and informal learning experiences in which educators engage to increase their knowledge about mathematics content and pedagogy. PL may consist of workshops, professional-learning communities, or lesson study (Huang & Shimizu, 2016), but PL can include any activity in which educators engage to increase their content or pedagogical knowledge. PL can be provided face-to-face or virtually, *with the virtual component particularly important for educators in rural settings* (Francis & Jacobsen, 2013).

Coaching provides individualized PL to support outcomes for students with MD. Although PL may improve educators' ability to effectively deliver intervention, educator change is very difficult to achieve, and the PL literature states that educators may not be able to apply what they have learned from traditional PL courses. Hence, many schools are enlisting the help of instructional coaching to support the teaching and learning of math (McGatha et al., 2015).

Research has shown that PL paired with instructional coaching can sustain and improve many aspects of educator practice such as professional knowledge, classroom instruction, use of evidence-based practices, self-efficacy, and educator learning (Kretlow et al., 2012). Often, there is a disconnect between PL activities and educators' actual classroom practice, resulting in a lack of intended outcomes. Coaching helps educators translate new knowledge from PL activities into classroom practice, leading to more effective teaching practices and ultimately improved student performance (Kraft et al., 2018). Moreover, staff in OOS settings often benefit from on-the-job training that addresses individualized and targeted challenges (Skelley et al., 2022).

Coaching is most beneficial when it includes four effective practices: using alliance strategies, observing, modeling, and providing performance feedback (Dunst et al., 2015). Coaches apply the four effective coaching practices with educators in a three-phase recursive cycle. In phase 1, coaches conduct a pre-meeting with the coachee(s). In phase 2, coaches work directly in the classroom with educators or attend team meetings. In phase 3, coaches conduct a post-meeting with the educator/team to provide performance feedback (e.g., sharing notes from observations, product reviews, checklist data, etc.). A final critical coaching practice includes the development of a positive educator–coach relationship, also referred to as alliance. Strong alliance between educators and coaches establishes a solid foundation for subsequent work.

In this Expansion project, we design and test online LP and virtual coaching focused specifically on elevating and strengthening interventionists' pedagogical and content knowledge for supporting students with MD (*Absolute Priority 3*). As described in Aim 1 in Section C.2, we intentionally design the online LP and virtual coaching to focus on (1) evidence-based instructional strategies for supporting students with MD based on the IES Practice Guide (Fuchs

et al., 2021), (2) mathematics content knowledge for upper elementary with an emphasis on fractions, and (3) intensification strategies for students who need additional instructional support.

B. Strategy to Scale

(1) Strategies to Address a Particular Barrier

Barrier 1: Rural educators are not prepared to support students experiencing MD. Educators in rural schools have limited access to effective interventions and PL opportunities to effectively and with fidelity provide evidence-based interventions to students with MD. In a survey of over 250 rural math educators, most educators indicated that they were uncomfortable teaching students with MD and had limited knowledge about evidence-based practices (Hott et al., 2019). Moreover, most educators reported that they had minimal access to PL focused on implementing evidence-based practices. These findings replication other studies (Skyhar, 2020) indicating the lack of high-quality PL experiences for rural educators. **Solution Strategy 1: Replicate and extend evidence of effectiveness for *FFO* in rural schools. Provide PL opportunities to rural educators.** We plan to replicate and extend strong evidence of effectiveness of *FFO* in rural settings in Grades 4-5. We develop online PL courses and ongoing coaching to improve educators' understanding of and confidence in providing evidence-based practices to students with MD.

Barrier 2: OOS service providers are not prepared to support students experiencing MD. Although OOS programs have been touted as a solution to accelerating math learning (Fahle et al., 2024), little is known about the math instruction OOS service providers offer. To catch up from the significant losses experienced due to the pandemic, students need access to effective high-dosage programs that are proven to improve math outcomes. **Solution 2: Replicate and extend evidence of effectiveness for *FFO* in OOS settings. Provide PL opportunities to OOS service providers.** We will extend rigorous evidence of effectiveness of *FFO* as a strategy for providing high-dosage math tutoring in OOS settings. We develop online PL courses and ongoing coaching to improve OOS service providers capacity to (1) deliver high-dosage tutoring and (2) deliver efficacious interventions for students experiencing MD.

Barrier 3: Evidence-based interventions do not improve outcomes if they are not implemented with fidelity. Although millions of dollars were spent on implementing evidence-based solutions to ameliorate learning loss due to the pandemic, limited success toward pandemic recovery was achieved. As a reason for the lack of success, district leaders reported significant challenges implementing these practices with fidelity (Carbonari et al., 2022). Without ongoing monitoring coupled with timely feedback of fidelity of implementation, evidence-based interventions will not be effective at accelerating learning. **Solution 3: Remotely monitor fidelity to provide immediate and ongoing feedback to improve fidelity.** We use large-language models (LLMs) developed by [redacted] at our collaborating university (University of Virginia) to measure fidelity of implementation within each *FFO* lesson. Following LLM development and validation, the resulting fidelity measures serve two purposes: (1) provide interventionists with in-the-moment feedback on implementation, via a dashboard, to improve on-going intervention delivery, and (2) serve as a summative measure of fidelity which will be used to explore variability in effects (see Appendix J for outline of approach).

Barrier 4: District screening procedures for Tier 2 interventions may be inaccurate. Districts across the U.S. use different methods to identify students needing Tier 2 interventions, including state test data, educator rating systems, and commercially available screening systems (Nelson et al., 2016). As commercial screening systems become more common, the accuracy and efficiency of the results for local decision-making may be called into question (Klingbeil et al., 2019). The outcomes of an inaccurate screening system could be dire: students in need of Tier 2 or 3 instruction may be denied essential services, or students who are making adequate progress may be unnecessarily served, which could over-burden the MTSS system. **Solution 4: Examine treatment effects based on the accuracy of screening procedures.** We explore the accuracy of the screening systems used by participating rural schools against a standardized screener (see Measures in Section D). We examine treatment effects based on the accuracy of schools' screening procedures to determine if variability in student outcomes is observed.

(2) Adequacy of Management Plan

This project is organized into 4 primary aims that will be conducted over a 5-year period. SMU, under the direction of PI [redacted], is responsible for overall project direction and management. WestEd serves as an independent evaluator with [redacted] serving as the Project Director. MU (led by [redacted]) and UT (led by [redacted]; identified as a Minority Serving Institution [MSI]) are implementation partners. Four collaboration partners support the project: University of Virginia (led by [redacted]), University of Hawaii (led by [redacted] and [redacted]; identified as an MSI), Georgia State University (led by [redacted]; identified as an MSI), and University of California, Riverside (led by [redacted]; identified as an MSI). We address *Competitive Preference Priority 1* by collaborating with 4 partner universities that are identified as minority-serving institutions.

[redacted] will meet weekly via Zoom to evaluate progress toward meeting project goals. [redacted], and [redacted] will participate once per month to ensure implementation of project activities with fidelity. WestEd will participate twice per month to review evaluation efforts. All of the core team will meet in-person twice per year – once at SMU and once at a national conference. As previously noted, [redacted] have a strong history of effective collaboration to implement school-based research initiatives, including a mid-phase EIR-funded project (S411B210032). This track-record of successful partnership will decrease the likelihood of communication challenges that might impact the success. Tables 1-4 in Section C.2 identify the timeline and responsible party by aim.

PI [redacted] will facilitate implementation of the rigorous research activities designed in collaboration with WestEd. She will oversee the program activities and work directly with all Project Directors (PDs) to facilitate implementation at their sites. Moreover, she will work directly with WestEd to facilitate their ability to conduct an independent evaluation.

PDs [redacted] will work with their site coordinators to recruit participants. PDs are well qualified to develop online PL courses and virtual coaching models; they regularly provide PL to in-service educators, have deep understanding of math, and have extensive experience designing, implementing, and evaluating intervention research.

PDs [redacted], [redacted], [redacted], [redacted], and [redacted] will recruit participants and support implementation at their sites. PDs are well established in their communities and have existing partnerships with rural school districts and OOS providers.

SMU Data Manager ([redacted]) will oversee data collection and storage for all project data. She will work directly with site coordinators at SMU, MU, and UT to ensure proper data handling procedures are followed and confidentiality is maintained, in accordance with the Institutional Review Board policies and requirements. [redacted] has over 12 years of experience as a Research Project Manager and has managed multiple federally-funded projects in the past, including multi-site projects. By assigning these responsibilities to an experienced project manager, the likelihood of maintaining confidentiality and data integrity is increased.

To aid in data collection and management, [redacted] will work directly with SMU's Data Center. The Data Center supports general computing and collaboration with other research partners and is designed to (a) facilitate acquisition of data, (b) develop tools and procedures for ensuring and monitoring the accuracy and confidentiality of data, (c) facilitate communication and compiling of data, (d) provide confidential storage of data, and (e) provide statistical support. SMU provides network storage to include mapped network drives accessed through the domains my.SMU and BOX.smu.edu that are available only to faculty and staff and are used for secure data storage; data are stored in a secure folder to which only key project personnel have access. These servers are routinely backed up to prevent data loss. Data will be permanently deleted using a secure data deletion software; hard-copy data will be securely destroyed.

Site coordinators will recruit interventionists, schedule pre- and post-testing, monitor completion of training and PL courses, schedule virtual coaching, and monitor results of fidelity observations. Site coordinators have extensive experience working on grant-funded projects, have existing relationships with schools, and are well-versed in implementing interventions.

Graduate students with experience in math and/or special education will be recruited at each site as research assistants. We will use recruitment activities that encourage applicants from underrepresented populations. Further, the collaborating universities affirm and actively protect

the rights of all individuals to equal opportunity in education and employment without regard to race, color, sex, national origin, age, religion, marital status, handicap, veteran status, sexual orientation, or any other extraneous consideration not directly and substantively related to effective performance. As applicable, the project will make efforts to employ and advance in employment qualified individuals with disabilities (see section 606 of IDEA). Research assistants will support data collection activities, coach interventionists, and monitor fidelity.

Described in greater detail below, WestEd will conduct an independent evaluation.

(3) Applicant's Capacity

SMU serves as the lead for this project under the direction of PI [redacted], with two key implementation partners: (1) University of Missouri (MU) led by PD [redacted] and (2) The University of Texas at Austin (UT) led by PD [redacted]. WestEd (led by PD [redacted]) serves as the independent evaluator. We also work with four collaboration partners: University of Virginia, University of Hawaii, Georgia State University, and University of California, Riverside. To address *Competitive Preference Priority 1,* four of our partner universities are identified as minority-serving institutions. Together, we are well qualified to implement this rigorous research project at a national scale.

Qualified Personnel for Key Partners (see CVs in Appendix B)

[redacted], PI and SMU Project Director, is a Professor and the Texas Instruments Endowed Chair in Education, and the Director of the Research in Math Education unit. Since 2006, she has secured over [redacted] in external funding from the EIR, IES, NSF, OSEP, and other sources to develop and validate assessment and instruction systems in math to support students with MD. She is responsible for overall project direction and management.

[redacted], MU Project Director, is Professor in the Dept. of Special Education. She has been awarded close to [redacted] in external funding as PI/co-PI from IES, OSEP, and other sources since 2003 to develop and validate assessment and instruction systems in math and writing for students academically at-risk. She will oversee and direct the MO activities.

[redacted], UT Project Director, is a Professor in the Dept. of Special Education.

She has acted as PI or Co-PI on over [redacted] in research funded by IES, OSEP, National Science Foundation, and EIR. [redacted] has authored or co-authored over 100 peer-reviewed manuscripts. She will oversee and direct the UT activities.

[redacted], Evaluator, is a Research Director of a team of highly qualified quantitative and qualitative researchers at WestEd. [redacted] has conducted numerous RCTs, including EIR Early Phase, MidPhase, and Expansion projects. He has over 120 peer reviewed publications and is a WWC reviewer certified in experimental, quasi-experimental, and single-case research designs. He and his team will oversee all evaluation activities.

Qualified Institutions of Key Partners

SMU has an established track record of innovative research supported by outstanding researchers, high-quality library resources, and a robust technology infrastructure to implement our project goals successfully. Located in Dallas, Texas, SMU is a private secular university of approximately 12,000 students from diverse economic, ethnic, and religious backgrounds. The Simmons School of Education is ranked in the top 15 in the nation for private schools by U.S. News and World Reports (2024). SMU's 10 libraries house nearly three million volumes including over 440 online databases, 38,000 electronic journals, and 300,000 electronic books.

The Budd Center at SMU will support engagement with OOS partners in North Texas. As a collaborative organization uniting 33 nonprofit organizations – most of whom provide OOS support for underserved students in Dallas – the Budd Center facilitates a university-community partnership and will support recruitment of OOS programs such as [redacted] and [redacted]. Also, we disseminate findings through their network.

MU College of Education and Human Development has a strong commitment to research, professional training, and service. As a member of the American Association of Universities and a university classified as a "community engaged campus" and "research university/very high" by the Carnegie Foundation for the Advancement of Teaching. In research, the college's grant expenditures in FY 2020 totaled more than $21.5 million. Department of Special Education is ranked 21st on the U.S. News and World Report, 2021 rankings.

UT Austin includes 18 different colleges and schools in which almost 52,000 students are engaged in over 270 fields of study and has more than 90 organized research units. The College of Education at UT is a leading education with 5 departments including the 6th ranked Department of Special Education. The Department of Special Education, along with The Meadows Center for Preventing Educational Risk (MCPER), have won research grants exceeding $100,000,000 over the last decade.

WestEd is a preeminent not-for-profit educational research, development, and service organization with over 1,000 employees and 13 offices nationwide. WestEd is currently the independent evaluator for two EIR Expansion projects, and has extensive EIR experience as both independent evaluator and prime organization.

Appendix J denotes the qualifications of our Collaboration Partners, including the University of Hawaii, University of California at Riverside, and Georgia State University, all of whom are minority serving institutions, thereby aligning with *Competitive Preference Priority 1.*

(4) Mechanisms for Dissemination

Through targeted dissemination, we aim to accomplish two goals: (1) enhance awareness and training on evidence-based fraction interventions in rural and OOS settings, and (2) increase understanding of the role of professional learning on effective implementation of interventions. First, we seek to increase awareness and access to training. We will connect with relevant networks (such as the National Rural Education Association and the National Afterschool Association) to share information through direct communication, informational sessions, and targeted outreach. We update the website for our current mid-phase EIR project, Project SCALE, to have resources specifically for rural schools and OOS settings. These materials will be provided free of charge. We will monitor website statistics (e.g., subscribers, views, watch time) to determine users' engagement. We use these statistics to inform updates to the site. SMU will continue maintenance of the website once funding has concluded.

Second, we will disseminate research findings to both researchers and practitioners within special education and math education communities, particularly those who work with

underserved populations (i.e., rural and out of school settings). We build on our successful track record of publishing in peer-reviewed research- and practitioner-oriented journals as well as presenting at related conferences. We share our findings in journals such as *Rural Special Education Quarterly*, *Journal of Research in Rural Education*, *Learning Disabilities Research & Practice*, *Journal of Special Education*, and *Exceptional Children*. We share findings at national conferences, such as the National Forum to Advance Rural Education and the annual conference of the National Afterschool Association, as well as the Council for Exceptional Children and National Council of Teachers of Mathematics. To benefit our regional communities, we connect with associations such as the Small and Rural Schools Network in Texas and present at such conferences as the annual Texas Rural Schools Conference.

Third, we will directly engage with rural schools and OOS service providers. We will host webinars – free of charge – each year to describe mechanisms to engage and support students with MD. We will disseminate via SMU's Budd Center and UT's Dana Center for Rural Schools Network. We will invite interventionists to present with us to share their experiences. We will collect attendance data for each session and will send evaluations.

(5) Utility of Products

The target populations for this project are interventionists (either educators in rural settings or tutors in OOS programs) and the students with MD they support. The products have a high probability of being useful for these populations. First, the *FFO* manual is designed to outline essential instruction within each of the 36 lessons. It was designed to be purchased by any adult and provide all the information and materials necessary for implementation. Second, will have virtual training available about *FFO* and the use of the 36 lessons. Third, we will have online PL courses and a coaching model that provides continual support to interventionists with their use of *FFO*. Our *FFO* educators from our mid-phase project of *FFO* have noted how easy *FFO* is to use, and they liked the virtual training for *FFO*.

With a focus on students, for the last decade, students with MD have demonstrated improved fraction and math outcomes after participating in the *FFO* intervention. Not only did

the developers of *FFO* (Fuchs and colleagues) note the utility of *FFO*, but our team ([redacted], [redacted], and [redacted]) has identified a similar pattern of results with our mid-phase project. That is, student demonstrate improved fraction knowledge after participating in *FFO*. This meets the expectations for *Absolute Priority 1* and *Competitive Preference Priority 2.*

C. Quality of Project Design

(1) Conceptual Framework Underlying SCALE-UP for *FFO*

This project is based on the underlying theory of change that *FFO*, when implemented with fidelity, will lead to improved outcomes for both students and interventionists as measured by standardized tests and researcher-developed measures (see Logic Model in Appendix G). We expect improvements in student outcomes will hold for students in rural and OOS settings when interventionists are provided supports that include *FFO* training, professional learning (including professional development and coaching), and fidelity feedback, along with the materials. We hypothesize that interventionists will increase their sense of self-efficacy for supporting students with MD and improve their fraction knowledge through participation in *FFO*, while developing stronger pedagogical skills. We hypothesize that the positive outcomes we realize for interventionists and students will sustain over time.

(2) Specific and Measurable Goals, Objectives, and Outcomes

The purpose of this proposal is to rigorously evaluate *FFO* (Fuchs et al., 2013), a math intervention that has strong evidence of effectiveness for students with MD at a national level, with new populations in two novel settings – rural schools and OOS programs. Because interventionists in rural schools and OOS programs may lack strong pedagogical and content knowledge needed to effectively delivery math intervention, we seek to understand the impact of providing PL and coaching. We reach our **four primary aims**.

AIM 1. To address *Absolute Priority 3* by elevating and strengthening the interventionists in rural schools and OOS settings, we design online PL courses and a virtual coaching model using best practices. We build on our collective expertise in designing and delivering university-level courses to help teachers support students with MD to design a 3-credit

online course delivered via Canvas (learning management system housed at SMU). Specifically, integrate the expertise of our implementation partners (PDs [redacted], [redacted], and [redacted]) who have extensive experience designing courses that embed culturally sustaining practices. This course will meet the rigorous academic requirements for graduate-level coursework at SMU; participants completing the course will receive course credits at no charge (tuition is partially cost shared by SMU). The course will be divided into three modules, each with 15 contact hours (or the equivalent of 1-credit) and will focus on (1) evidence-based instructional strategies for supporting students with MD as outlined in the IES Practice Guide (Fuchs et al., 2021), (2) mathematics content knowledge for upper elementary with an emphasis on fractions, and (3) intensification strategies for students who need additional instructional support.

Also in spring 2025, we refine our coaching model. We build off a successful IES-funded grant (Project STAIR 2.0; R324X220102) to deliver coaching for educators working with students with MD awarded to PD [redacted] and supported by PD [redacted] and PI [redacted]. The coaching process includes the following key elements: a collaborative partnership between educator and coach; accountability; a cycle of setting goals, working towards goals, and adjusting based on goal attainment; creating clearly defined roles, responsibilities, and well-trained coaches. In spring 2027, we create additional online PL courses for interventionists in OOS settings that focuses on building their understanding of and confidence in providing small group academic interventions for students with MD. Annually, we iteratively refine the PL and coaching models by integrating intentionally solicited feedback from users. PL and coaching models will be made publicly available.

Aim 1: Develop online PL and virtual coaching model	Spr 25	25-26	26-27	27-28	28-29	Fa 29	Who is Responsible?
Develop online PL for rural interventionists	X						PDs; IP; Coordinator
Develop online PL for OOS			X				PDs; IP;

interventionists							Coordinator
Develop virtual coaching model, train coaches	X	X	X				PDs; IP; Coordinator
Conduct focus groups, refine PL and coaching		X	X	X	X		Coordinator; RAs
Data analysis, dissemination			X	X	X	X	PDs; WestEd

PD: Project Directors; IP: Implementation Partners; RA: Research Assts.

AIM 2. Based on the strong evidence of effectiveness for improving fractions and general math outcomes for students with MD, beginning in 2025-26, we examine whether positive impacts of *FFO* (Fuchs et al., 2013) can be successfully reproduced and sustained over time with students with MD in rural schools. In 2025-26, 2026-27, and 2027-28, we recruit a total of 180 interventionists in Grades 4-5 who each work with 3-5 students with MD. Interventionists will be randomly assigned to condition: *FFO* plus PL, *FFO* plus PL and coaching, or BAU plus PL.

All *FFO* interventionists will be trained to implement *FFO* with fidelity using virtual training materials created and rigorously evaluated with funding from our mid-phase grant (S411B210032). Interventionists assigned to *FFO*+PL will complete the online PL course with fidelity. Interventionists assigned to *FFO*+PL+Coaching will complete the PL with fidelity and receive ongoing coaching every 6 *FFO* lessons from a trained RA. Interventionists assigned to BAU will implement their regularly planned activities and complete the online PL.

We evaluate changes in students' fractions knowledge and general math outcomes during the implementation year and for one year after. Changes in interventionists' fraction knowledge, pedagogical content knowledge, and self-efficacy for providing math intervention for students with MD will be evaluated. Fidelity of *FFO* and BAU instruction will be routinely monitored.

Aim 2: Replicate/extend in rural schools	Spr 25	25-26	26-27	27-28	28-29	Fa 29	Who is Responsible?

Recruit 180 interventionists; randomly assign		X	X	X			PDs; IP; Coordinator
Train *FFO* interventionists		X	X	X			Coordinator; IP; RAs
Recruit students with MD		X	X	X			IP; Coord; RAs
Complete online PL and virtual coaching		X	X	X			Interventionist; RAs
Implement *FFO*, collect pre-post data, monitor *FFO* fidelity & BAU, interviews		X	X	X			IP; Data Manager; RAs; WestEd
Collect follow-up data			X	X	X		IP; Data Mang
Data analysis, dissemination		X	X	X	X	X	PDs; WestEd

AIM 3. Due to a lack of efficacious models for providing high-dosage tutoring in OOS settings, we investigate the effectiveness of implementing *FFO* with students with MD in OOS settings. We work with OOS organizations to recruit service providers who serve as interventionists. In 2026-27, 2027-28, and 2028-29, we recruit a total of 180 interventionists who work with Grade 4-5 students with MD in OOS settings. Just as in Aim 2, interventionists will be randomly assigned to condition: *FFO*+PL, *FFO*+PL+Coaching, or BAU+PL. We evaluate changes in students' fractions knowledge and general math outcomes during the implementation year. Changes in interventionists' knowledge of fractions, pedagogical content knowledge, and self-efficacy for providing math intervention for students with MD will be evaluated. Fidelity of *FFO* and BAU instruction will be routinely monitored.

Aim 3: Effectiveness in OOS settings	Spr 25	25-26	26-27	27-28	28-29	Fa 29	Who is Responsible?
Recruit 180 service providers; randomly assign			X	X	X		PDs; IP; Coordinator

Train *FFO* interventionists			X	X	X		PDs; IP; RAs
Complete online PL; coaching			X	X	X		Interventionist; RAs
Recruit, screen students with MD			X	X	X		Interventionist; RAs
Implement *FFO*, collect pre-post data, monitor *FFO* fidelity & BAU, interviews		X	X	X			IP; Data Manager; RAs; WestEd
Data analysis, dissemination			X	X	X	X	PDs; WestEd

AIM 4. Because we are implementing at a national scale and in rural schools and OOS settings, efficiently monitoring fidelity of implementation (FOI) is critical. To increase the likelihood of sustained positive improvements in student outcomes over time, we develop and study the effectiveness of a technology-enhanced FOI system. Using machine learning techniques, we refine a large-language model (LLM) developed by PD [redacted] in collaboration with [redacted] (see Appendix C for letter of commitment) to monitor treatment fidelity.

In spring 2025, we refine the LLM and train it to detect deviations in implementation of the scripted lessons from the *FFO* administration manual. In 2025-26, we test the LLM using audio recordings of interventionists delivering the *FFO* lessons. Interventionists will audio record themselves using project-provided tablets; audio files will be uploaded to a secure file storage system. These data will be analyzed in two ways: First, our trained graduate students will use the *FFO* Fidelity Checklist developed in our mid-phase EIR project (S411B210032). Second, the LLM will analyze the correspondence between the audio recording and the scripted *FFO* intervention, identifying sessions where their audio recording substantially deviates from the intervention as planned. Once the LLM has reached 90% agreement with the human rater, with a sensitivity rate of greater than 0.9, we will use the LLM throughout implementation to flag low-fidelity sessions. Also, we develop a dashboard to provide feedback to interventionists.

Aim 4: Develop treatment fidelity system	Spr 25	25-26	26-27	27-28	28-29	Fa 29	Who is Responsible?

Refine/ train existing LLM on *FFO*	X						PDs; [redacted]
Test LLM to reach accuracy		X					[redacted]; RAs
Develop dashboard for interventionists		X					PDs; [redacted]
Implement LLM treatment fidelity			X	X	X		Data Manager

Implementing *FFO* in Rural Schools and OOS Settings. We partner with rural schools and OOS providers (see Appendix C for letters of support). We use an innovative approach for recruitment by collaborating with the Special Education Research Accelerator housed at UVA led by PD [redacted]. We crowdsource participation following standardized protocols (see Appendix C for Letter of Support).

Within the rural school context, we work with schools who have independently decided to implement MTSS, and therefore, already have designed their schedules to provide time for intervention support and identified the school-based personnel (e.g., interventionists) who will provide intervention. In these rural schools, *FFO* will be implemented during the school day at the designated intervention time. No changes to the publisher-specified implementation procedures will be made: *FFO* will be administered in small groups of 3-5 students for 3 sessions per week of approximately 30-35 min each.

Within OOS settings, we work with the staff members who are already employed by the OOS program; they will serve as interventionists. We will work with the organizations to schedule the intervention sessions at a convenient time. No changes to the publisher-specified implementation procedures will be made: *FFO* will be administered in small groups of 3-5 students for 3, 30-35 min sessions per week. Because OOS settings may have different configurations and interventionists may not have access to white boards and/or resources to display visuals, each interventionist will receive a tablet and stylus.

Identifying Students with MD in Rural Schools and OOS Settings. From 2019-2022, students lost more than 0.50 grade levels in math. Although the average student gained 0.17

grade levels in 2022-23 (Fahle et al., 2024), many students are struggling to catch up. Moreover, students experiencing MD prior to the pandemic have not recovered at the same rate and continue to experience significant difficulty in math (Lewis & Kuhfeld, 2023).

Within rural contexts, we work with schools who are already implementing MTSS, and therefore, have a screening system in place. However, because schools may have difficulty accurately identifying students with MD and to ensure comparability across sites, we will identify eligible students using screening process described in the Quality of Project Evaluation.

Within OOS settings where no screening systems are currently used, we identify eligible students using a screening process described in the Quality of Project Evaluation section.

Selecting Interventionists. To examine whether positive impacts of *FFO* can be successfully reproduced and sustained over time in rural schools and OOS settings, we work with educators who are already identified and hired to provide intervention or services. We expect qualifications of these educators will differ. The publisher notes that *FFO* can be administered by a range of professionals, including paraprofessionals, educators, and other specialists (e.g., math specialist). All interventionists implementing *FFO* will receive training on how to implement the intervention.

***FFO* Training.** As part of the mid-phase EIR grant (S411B210032), we developed a virtual training course to support efforts to scale up *FFO*. The virtual training course is delivered via an online course platform that is freely hosted by Bridge-RI (https://www.mtssri.org). The training mirrors the publisher recommendations: Interventionists receive approximately 15 hours of training on how to implement *FFO*. The training includes an overview of the program goals and procedures, video examples of each activity, and practice opportunities. Training occurs as part of the interventionists' regularly scheduled duties. Participating schools and organizations have agreed to provide substitute coverage or release time for personnel to attend the training (as part of the cost matching). Successful completion of the virtual training course will be monitored by usage logs that track when and for how long interventionists access the course.

(3) Appropriate and Will Address Needs of Target Population

First, we work with rural and OOS interventionists who provide support to students with MD. Researchers have demonstrated that many educators show novice and limited understanding of fractions (Chinnappan & Forrester, 2014). This might be particularly true for educators in rural or OOS settings who may not have access to high-quality PL and coaching about fraction instruction. With our online PL and coaching model (along with the *FFO* program with its systematic lesson guides), we hypothesize that, just as student knowledge of fractions increases through participation in *FFO*, interventionists' knowledge about fractions may increase through the use of *FFO*. This knowledge should not fade even if interventionists discontinue using *FFO*.

Second, we focus on students with MD. Important to this project, Jordan et al. (2013) observed that Grade 4 students with MD who struggle with fractions continue to score significantly lower on fractions tasks in Grades 5, 6, 7, and 8. However, evidence suggests that students with MD can improve their overall competence with fractions by developing their fraction knowledge. In *FFO*, interventionists explicitly teach fraction concepts and procedures. This explicit modeling with embedded practice opportunities is essential for students with MD (Fuchs et al., 2021), especially the opportunities to respond that students have during modeling and practice. *FFO* emphasizes the academic language of fractions to ensure students understand all discussions and can engage in discourse about fractions. *FFO* uses multiple representations, such as fraction tiles and area models, to allow students an opportunity to develop a deep understanding of fraction concepts and procedures. Furthermore, students build fluency with fraction operations and learn how to solve fraction word problems through guided and independent practice opportunities with educator feedback.

D. Quality of the Project Evaluation

WestEd will lead an independent evaluation of SCALE UP for *FFO* and conduct 2 rigorous multi-state cluster RCTs. [redacted] will lead the evaluation and brings extensive EIR evaluation experience, including as PD for a 2023 EIR Expansion project. WestEd has extensive experience with WWC and many staff are certified by WWC with deep knowledge and experience conducting studies that meet WWC standards without reservations. Both RCTs will

meet WWC standards version 5.0 without reservations. The evaluation measures are valid, psychometrically reliable, and aligned with WWC's Evidence Review Protocol domains. Like past RCTs of *FFO*, we expect these RCTs to have low interventionist attrition because of strong incentives and personal connections to rural school leaders. We expect low student attrition and non-response because of rigorous data collection monitoring. WestEd will assess fidelity of implementation (FOI) and conduct cost analyses to establish a sustainable model beyond the project. We are confident in our ability to execute the study with fidelity and low attrition.

The evaluation will address these questions:

Research Question	Data Sources
Confirmatory Questions	
1. What are the intent-to-treat (ITT; *FFO*+PL and *FFO*+PL+Coaching combined) effects of *FFO* on the general math outcomes for students with MD relative to the business-as-usual (BAU) condition?	Stanford Achievement Test-10 (SAT-10): Problem Solving; SAT-10: Procedures
2. What are the ITT effects of *FFO* on the state math achievement test performance (school-based RCT only) for students with MD relative to the BAU condition?	State achievement test score and performance level
3. What are the ITT effects of *FFO* on the fraction knowledge, fraction arithmetic, fraction comparison, ordering fractions, and understanding the fraction number line of students with MD relative to the BAU condition?	Select NAEP items; Vanderbilt Fractions Battery (VFB); Fraction Number Line
4. What are the ITT effects of *FFO* on the self-reported math anxiety and math efficacy of students with MD relative to the BAU condition?	Mathematics Anxiety Survey (MAS); Mathematics Efficacy Survey (MES)
5. What are the effects of *FFO*+PL+Coaching relative to	All RQ 1-4 measures

FFO+PL or the BAU conditions on RQ 1-4 student outcomes?	
Exploratory Questions	
6. What are the effects of *FFO*+PL+Coaching relative to *FFO*+PL or the BAU conditions on interventionists fraction knowledge, Math Knowledge for Teaching (MKT), and self-efficacy?	Compare to 3/5; FNL; Mathematics Teaching Efficacy Belief Instrument (MTEBI); MKT
7. Do student (e.g., race/ethnicity, special education status), interventionist (e.g., years teaching, certification), or school/site (e.g., state/region) characteristics moderate treatment effects for outcomes in RQ 1-5?	School/Site records Intervention survey All RQ 1-4 measures
8. Do interventionist or school/site characteristics moderate treatment effects for interventionist outcomes in RQ 5-6?	School/Site records All RQ 6 measures
9. Do interventionists' fraction knowledge, MKT, or self-efficacy mediate student ITT treatment effects?	All RQ 1-6 measures
10. Does fidelity of implementation mediate student treatment effects for *FFO*+PL+Coaching relative to *FFO*+PL?	*FFO* fidelity measures All RQ 1-4
11. How accurately do schools and community-based sites identify students with MD? How many students receiving *FFO* are performing at or below the 35%ile on the SAT-10?	SAT-10

(1) Evidence Will Meet WWC Standards Without Reservations

WestEd and SMU have designed two independent RCTs and each will meet WWC standards without reservations if executed as designed. We will recruit 180 interventionists in rural schools for RCT_1 and 180 interventionists in OOS programs for RCT_2. All study procedures will be identical in both RCTs, with two exceptions: (1) we will NOT collect state achievement test scores for students in OOS programs because we will not be working with

schools, and (2) we will collect student demographic information directly from parents instead of from school records. All other measures and procedures will be the same in both RCTs.

We will recruit schools and OOS programs from at least six states across the US (see Appendix C). Each year for three consecutive years, we will recruit 60 interventionists for RCT_1 beginning in Fall 2025 and 60 interventionists for RCT_2 beginning in Fall 2026. Interventionists will be randomly assigned, separately for each RCT, into one of three conditions: *FFO*+PL+Coaching, *FFO*+PL, or BAU+PL. ITT analyses will combine *FFO*+PL+Coaching and *FFO*+PL conditions into a single *FFO* condition and compare to BAU. Thus, ITT will be unbalanced, with ~66% interventionists in the *FFO* condition and 33% in the BAU condition. Follow-up analyses will compare intervention and student outcomes between the three treatment conditions (RQ5).

For both RCTs, each interventionist will work with an average of 4 students with MD. Students will be identified with MD and referred to *FFO* by their school or OOS programs. RQ11 will explore how accurately schools and OOS programs identify students for MD. We will collect information about the types of measures used to identify students for MD but will not inform or advise on each sites' procedures so that the study results are generalizable to typical educational practice. At the end of the evaluation phase, we anticipate having data from 180 interventionists and 720 students with MD in ***each*** RCT (60 interventionists and 240 students with MD in each treatment condition). Put differently, SCALE-UP for *FFO* will work with 360 interventionists and 1,440 students with MD overall.

Following interventionist consent, identification of students with MD, and collection of all baseline measures, WestEd will randomly assign interventionists to one of the three treatment groups. Random assignment will occur within school/site blocks to ensure balanced assignment within schools/sites. Contamination will be closely monitored by the SMU team through contact with each interventionist and formative data collection by WestEd. WestEd will carefully track student rosters, attrition, and non-response throughout the study. Student joiners (students with MD identified and referred to an interventionist after randomization) will be excluded from

baseline and analytic samples per WWC standards. As an incentive to participate and remain in the study, all interventionists will receive a financial stipend and all interventionists, including those in the BAU condition, will receive math PL as described above. In the ***unlikely event*** of higher-than-expected attrition, our collection of student-level pretest data and block randomization ensures baseline equivalence between groups, and students matched using propensity scores, allowing the study to meet WWC evidence standards with reservations.

Statistical Power. To achieve statistical power of .80 for each RCT, we assumed a total sample of 160 interventionists and a harmonic mean of 4 students with MD per interventionist, a .05 alpha level, and different ICC and variance scenarios (see Appendix J for details). The ITT minimum detectable effect sizes (MDES) ranged from is .15 to .18 for student outcomes. Effect sizes from prior *FFO* RCTs ranged from 0.91 to 2.50 for student outcomes (Fuchs et al., 2013).

Measures. All measures described below have evidence of reliability and validity. The pretest measures reduce residual variance in outcomes and increase precision of the impact estimate. The posttests will provide valuable estimates of *FFO*'s effect on students' math achievement and fraction knowledge. Interventionist outcomes provide insight about how PL and coaching influences educators' fraction knowledge and self-efficacy. All student measures will be given at pretest before randomization and after *FFO* implementation (~12 weeks). All outcomes align with the logic model in Appendix G. Details for measures are in Appendix J.

WWC-Eligible Outcomes Domain: Mathematics Achievement. Students will complete the SAT-10 (Pearson, 2007; a = .84) Problem Solving and Procedures subtests prior to randomization (pretest) and after completion of *FFO* (posttest). The SAT-10 provides scale scores (RQ 1,5,7,9,10), and percentile ranks (RQ11). We will also collect each students' math achievement score on their state math achievement measure (e.g., State of Texas Assessments of Academic Readiness [STAAR]; a = 0.85 to 0.90) to address RQ 2,5,7,9,10.

WWC-Eligible Outcomes Domain: Numbers and Operations. All students with MD will complete a fractions knowledge battery at pretest and posttest. The battery includes 130 items covering five different fraction domains: Fraction Understanding, Fraction Arithmetic,

Fraction Comparison, Ordering Fractions, and Fraction Number Line. The battery is currently being successfully used in our EIR Mid-Phase study (S411B210032). Students can complete the battery in ~30-min. Each subtest has evidence of validity and reliability (e.g., a = .94 for Fraction Arithmetic). The fractions battery will be used to answer RQ 3,5,7,9,10.

WWC-Eligible Outcomes Domain: Academic Dispositions. We will collect two student self-report measures pretest and posttest on academic dispositions. First, we will collect the Mathematics Anxiety Survey (Bai, 2011), a 14-item measure of students' positive and negative affect towards math using five-point agreement Likert scale items (a = .82). Second, students will complete the Mathematics Efficacy Survey (Umay, 2001), a 12-item measure of students' self-perception, awareness of fraction behavior, and ability to apply fractions as an everyday skill using a five-point frequency Likert scale (a = .73).

In addition to confirmatory student outcomes, we will collect a series of measures from the interventionists. First, we will collect a fractions knowledge battery pretest and posttest to evaluate interventionists' growth in the following subscales: Compare to 3/5 (a = .95) and Fraction Number Line (a = .87). We will also collect the Mathematics Knowledge for Teaching and Mathematics Teaching Efficacy Belief Instrument (a = .83) (RQ 6,8,9).

Implementation Fidelity Measures. WestEd, in collaboration with SMU, will also collect a series of FOI measures to evaluate the PL and coaching and educators' implementation of *FFO*. WestEd will create a series of FOI checklists and coaching logs. These will be collaboratively created during spring 2025. WestEd will work with [redacted], [redacted], and their team to incorporate the LLMs to measure FOI within each *FFO* lesson. Once validated, the LLM FOI measures will be used to collect data in **all** three treatment conditions.

Data Analysis. WestEd will use a series of hierarchical linear models (HLM) with students nested in interventionists to estimate all treatment effects. Aligning with random assignment procedures, treatment effects will be estimated at the interventionist level. We must note that we do not know how many schools or OOS programs will be recruited or how many interventionists will be within each school or community-based site. Currently, we assume that

there will be between one or two interventionists nested within each school/OOS program and will conduct exploratory analyses to address nesting if present (e.g., 3-level models [students/interventionists/schools or OOS programs]). Interventionist- and student-level covariates will be included to reduce residual error and increase power and precision. Treatment-by-moderator interactions will be added to examine moderation. Mediation will be estimated using multi-level structural equation models (ML-SEM; see Appendix J for specifications).

(2) Evaluation Will Provide Guidance About Effective Strategies Suitable for Replication or Testing in Other Settings

Data from this evaluation will provide evidence that interventionists can successfully implement *FFO* in rural schools and OOS programs with students with MD. Also, the two PL models will provide evidence about the level of support needed to successfully implement *FFO* in rural schools and OOS sites. This evaluation (1) includes a large sample representing multiple states and rural areas that are diverse in location, size, and student characteristics; (2) examines whether the impact of *FFO* varies by different interventionist, student, and school/OOS programs characteristics; (3) collects and analyzes high-quality FOI data; (4) includes a cost analysis of *FFO*; and (5) includes focus groups with participating interventionists to understand barriers and facilitators to implementation. Focus groups will be virtual and include at least 20% of the interventionists in each cohort. Collectively, these activities will inform the conditions under which *FFO* is likely to have the greatest impact.

Diverse Settings and Samples. The We meet the expectation of *Absolute Priority 1* by implementing at a national scale. We address this with two strategies. First, through our implementation partners and collaboration partners, we work directly with universities in six states that include many high-need rural schools and OOS programs. Such diversity will support the broad generalizability of *FFO*. Second, we engage with the University of Virginia's Special Education Research Accelerator (SERA; see Appendix C for letter) to recruit a national sample of rural schools and OOS programs. Crowdsourcing in a cost-effective, novel means for collecting large amounts of data from multiple and diverse sources and locations. SERA was

specifically designed to facilitate crowdsourced education research projects. Developed and piloted with funding from the Institute of Education Sciences, SERA consists of a cadre of researchers from across the country and a well-established infrastructure for collecting data across many research teams and sites.

SERA has demonstrated success in crowdsourcing educational research projects. The "Crowdsource Science" study, funded by NSF (NSF-2201464), currently involves data collection across the country. With only 1 year of data collection complete, SERA has already facilitated data collection in 14 states and 19 study sites.

For SCALE UP for *FFO*, we will innovatively crowdsource implementation by collaborating with experienced researchers from well-respected institutions of higher education across the U.S. Our nationwide crowdsourcing collaboration will allow us to work with a generalizable sample of U.S. elementary schools and students with MD. Seven universities have demonstrated commitment to participation (see Appendix C for letters of support).

Understanding Differential Impact. WestEd will examine moderators and mediators of treatment effectiveness (RQ7-10). Student, interventionist, and school/OOS programs moderators will be incorporated into HLM models via within- and cross-level treatment-by-moderator interactions. Moderating factors will include interventionist characteristics (e.g., years of experience), student characteristics (e.g., gender, ethnicity, disability status), and school/OOS programs characteristics (e.g., percentage of minority students). Results from these analyses will help identify settings or populations for which *FFO* is effective or not well suited. WestEd will also examine mediation models. The logic model specifies that interventionist fraction knowledge and math efficacy may mediate *FFO*'s impact on student outcomes. WestEd will use ML-SEM to test mediation effects given its superior ability to address the presence of measurement error and to account for the nesting of data (Little et al., 2007).

Analyses of Fidelity of Implementation Data. FOI is deliberately integrated into this study to address research question 10. We will examine FOI (e.g., the dosage and adherence) of *FFO* implementation. As part of Aim 4, we will develop a technology-based FOI monitoring

system and test it against the *FFO* Fidelity Checklist developed in our mid-phase EIR project (S411B210032). Additionally, we will collect a series of FOI data on the PL and coaching.

Cost Effectiveness. WestEd will conduct a cost analysis based on the Resource Cost Model (Levin & McEwan, 2002) to provide information about the cost of implementing *FFO*, including associated PL and coaching and whether it is cost effective relative to the BAU condition. Costs will be identified in both *FFO* conditions, as well as in the BAU conditions using the ingredients method (Levin et al., 2017). Analyses will identify the costs associated with each component of the program, distinguish start-up costs from ongoing costs, and convert total costs to per-interventionist and per-student costs. We will then combine the cost information and effect size estimates to describe the impact on a per dollar basis (Hollands et al., 2021).

(3) Plan clearly articulates key components, mediators, and outcomes, and threshold for acceptable implementation

WestEd will collect a rich set of implementation data, including coaching logs, FOI of *FFO* coaching, and interventionists' perceptions of the training, coaching, and *FFO*. Based on prior EIR RCTs, WestEd has set the following thresholds for acceptable implementation: (a) PL and coaching fidelity must meet >90% fidelity (sources: PL session rosters, PL FOI checklists, coaching logs); and (b) educator implementation of FFO must meet 80% fidelity (as measured by the *FFO* Checklist) and be implemented at least 2 times a week. WestEd will analyze these data monthly and send reports on fidelity of PL and coaching to make improvements as needed. We will model the relation between these key components and outcomes in RQ10.

WestEd will be directly involved with the project from Day 1. [redacted] and his team will meet with the SMU team weekly at the beginning of the project and then monthly as the team deems necessary. During Year 1, WestEd will provide weekly updates on project activities and, if any concerns arise, work with SMU to remedy all issues. WestEd will focus on maintaining randomization, attrition, data collection, student-level leavers and joiners, and controls against potential confounds to ensure this study meets WWC standards without reservations.

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