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Introduction and Absolute Priorities

Vanderbilt University, in collaboration with the University of South Florida, SRI International (evaluation partner), and eight partner school districts, proposes an Expansion-Phase Grant to expand and scale the *Pyramid Model* ([redacted] et al., 2003; [redacted] Ostrosky, & [redacted] 2021) in Prekindergarten (PreK) and Kindergarten (K) classrooms in diverse districts across the country. The *Pyramid Model* (*PM*) is an evidence-based classroom-wide approach to promoting social-emotional competence and addressing challenging behavior in young children ([redacted] et al., 2016; [redacted] et al., 2021). This project will include a rigorous evaluation of the implementation and impact of the *PM* across four states [redacted] with a diverse student sample, using a cluster-randomized trial design that meets What Works Clearinghouse (WWC) standards without reservations. PreK and K classrooms will be randomly assigned to participate in the *PM* intervention or a delayed intervention control condition.

This expansion application addresses two absolute priorities: **(a) Absolute Priority 1**: Strong Evidence (see Evidence Form; description page 9); and **(b) Absolute Priority 2: Innovative Supports and Interventions to Improve Student Achievement and Attainment** by scaling the evidence-based *PM*. Expansion of the *PM* also targets the **Competitive Preference Priority 2** by implementing effective prevention and promotion practices to counter the effects of COVID-19) on PreK and K students. A critical factor in supporting children's successful early school experiences is continuity across PreK and K in LEA settings. To support this continuity, we will implement the *PM* intervention and evaluation study in PreK and K classrooms serving high needs students including those who live in poverty; are at-risk for disabilities or poor school outcomes; are at-risk for being suspended/expelled; and those with social, emotional, or behavioral concerns related to the impacts of COVID-19.

A key component of this work will be the use of an evidence-based coaching model, Practice-Based Coaching (PBC; [redacted] et al., 2016; Snyder et al., 2022), to support teachers to implement *PM* practices in classrooms. A Mid-Phase EIR grant (2017-2022) allowed us to test a scaling strategy by building capacity of district personnel to coach PreK and K teachers to implement *PM* practices. Coaches in two districts were trained on the *PM* and PBC. Coaches met fidelity thresholds for delivering PBC, and they worked with teachers on the prescribed coaching schedule to support their teaching practices (https://studentbehaviorblog.org/practice-based-coaching-on-the-pyramid-model-it-builds-you-up-and-finds-your-strengths/). Preliminary results showed district coaches supported teachers to reach *PM* practice fidelity. Intervention teachers increased their use of *PM* practices while control teachers demonstrated relatively little change. These findings are consistent with findings from previous RCTs where coaching was delivered by research staff ([redacted] et al., 2021; [redacted] et al., 2016) suggesting that the scaling strategy to build district capacity by training district personnel as coaches was effective.

A. Significance

A.1 National Significance

Rapid development of the social, emotional, cognitive, and language skills that comprise social-emotional competence (Campbell et al., 2016) occurs during early childhood, broadly defined as birth to 8 years (National Association for the Education of Young Children [NAEYC], 2022). During this time, children are learning to engage in social relationships with peers and adults, respond to the emotions of self and others, regulate their own emotions and behavior, and engage in social problem solving. Research on students' academic success in K and early elementary has shown that greater social-emotional competence supports academic outcomes and positive relationships (Durlak et al., 2011; Jones et al., 2015; Korpershoek et al., 2016;

Morris, et al., 2013; Zins et al., 2007). PreK and K is a period in which early indicators of social-emotional difficulties that manifest as challenging behaviors become evident (Brennan et al., 2015; Egger & Angold, 2006; Shaw et al., 2012).

The prevalence and impact of social-emotional delays and challenging behavior in young children is a growing concern for families, educators, policy makers, and researchers (Benedict et al., 2007; Ringeisen, 2017; Squires & Bricker, 2007). At least 30% of children demonstrate challenging behaviors that interfere with their learning and development (Egger & Angold, 2006; Qi & Kaiser, 2003). Researchers have found an increased prevalence of challenging behaviors among preschool children who live in poverty (Carter et al., 2010; Qi & Kaiser, 2003), are exposed to violence, and have families with caregiver mental health issues (Carter et al., 2010).

Concerns about students' social-emotional development have increased during COVID-19 with youth experiencing double the rates of depression and anxiety compared to pre-pandemic estimates (Racine et al., 2021). In a national survey, 27% of families reported increases in child problem behavior (Patrick et al., 2020). Families of young children reported impacts on negative moods, sleep, and uncooperative behavior (Gassman-Pines et al., 2020). As a result of COVID-19, PreK and K children demonstrate delays across domains including language/literacy, and numeracy skills, and social-emotional delays (Tracey et al., 2022). The impact of COVID-19 is estimated to be more detrimental to high needs students (e.g., receive free/reduced price lunch) and students of color (Chen et al., 2022; Kuhfeld et al., 2021). The *PM* directly addresses the impact of COVID-19 by delivering practices that are evidence-based, equity-focused, and designed to support the social-emotional needs of students.

There is evidence that social-emotional and behavioral challenges that are severe and persistent in the early years are linked to emotional and behavioral disorders in older children

(Brennan et al., 2015; Bulotsky-Shearer & Fantuzzo, 2011; Miller et al., 2017). Research has shown that unaddressed social-emotional needs in the early years result in significant and negative consequences for students, classrooms, and schools. If students' social-emotional needs are not met and they continue to cycle through negative interactions with teachers and peers, they tend to disengage from learning and drop out of school, while also disrupting the learning of others and taxing the teacher and educational systems. For the past 40 years, researchers have all reached the same conclusion that intervention in the early years is more cost-effective and likely to prevent more significant social-emotional challenges (Carta & Young, 2019; Strain, 2017).

The early childhood years are critical for the development of social-emotional competence, but there is limited research on the continuity of supports from PreK to elementary school. There is evidence that large differences in type of instruction and teacher-child interactions between PreK and K can negatively affect students' academic development (Vitiello et al., 2022). Kindergarten teachers routinely identify students' social skills as more important to success in school than academic skills. In a recent study, K teachers reported that almost half of all children transitioning into K had difficulties related to social-emotional or behavioral issues, and one-third had difficulties in all areas (Jiang et al., 2021). Because K students are learning critical social-emotional skills and because the transition from PreK to K can be difficult for children with social-emotional needs, it is important to ensure continuity of supports for children during this transition. However, most social-emotional learning research includes only PreK children or only school-aged children and does not reflect the transition into K. Social-emotional interventions for school-age students are often geared toward older grades (WWC guide: https://ies.ed.gov/ncee/wwc/Docs/PracticeGuide/behavior_pg_092308.pdf), which may not be developmentally appropriate for K students (Durlak et al., 2011).

Further, data suggest that many teachers do not feel prepared to address the needs of students with social-emotional delays and challenging behavior (Bennedict et al., 2007; Freeman et al., 2014; Schonert-Reichl & Lawlor, 2010). Teachers struggle to provide the interactional and instructional supports needed to promote positive social-emotional development and prevent or address behavioral challenges (McClelland et al., 2017; McLeod et al., 2017). In the Survey of Early Education (U.S. Department of Health and Human Services, 2012), only 20% of teachers reported receiving training on promoting students' social-emotional competence. Elementary teachers also identify addressing social-emotional and behavioral needs as barriers to delivering effective academic instruction and as a primary support need (Oliver et al., 2011; Steed et al., 2021). When teachers do not have supports around students' challenging behavior, they may resort to asking for students' to be suspended or expelled (Brock & Beaman-Diglia, 2018).

National reports show an alarming use of exclusionary discipline practices in response to students' challenging behavior in public schools. The Overview of Exclusionary Discipline Practices in Public Schools (U.S. Department of Education Office for Civil Rights, 2021) showed that nearly 3,000 PreK children received one or more out-of-school suspensions in the 2017-2018 school year with rates that were disproportionate for boys and black children. While the overall rates had gone down since the prior report, there were no changes in the disproportionality rates. The rate of suspensions/expulsions across states varied with some states having rates as high as 13 per 1,000 students enrolled. More concerning is the evidence that state data may underreport exclusionary discipline practices (Whisman, 2015). Fabes and colleagues (2020) compared the PreK suspension/expulsion rates with those among older grades in the same school and concluded that schools reporting PreK suspensions/expulsions had higher overall rates than schools that did not report PreK suspensions/expulsions. The impact of exclusionary

discipline practices on young students is significant. When students are suspended or expelled, they not only miss the opportunity to learn social-emotional skills ([redacted] et al., 2021; [redacted] & Conroy, 2018) but they are removed from high-quality instruction focused on academic skills. Further, these exclusionary discipline practices may have negative long-term effects, such as disengagement from school, diminished educational opportunities, and expulsion in later school grades (Adamu & Hogan, 2015; Lochner & Moretti, 2004; Raffaele Mendez, 2003).

The pandemic further impacted teachers' ability to provide nurturing and supportive classroom environments. Prior to the pandemic, teachers who reported experiencing challenges such as personal or job-related stress were more likely to report the students in their classrooms having higher levels of behavior problems (Jeon & Wells, 2018). COVID-19 resulted in additional stressors for teachers, including learning to teach in different formats, coping with increased behavioral issues in children and more significant needs of families, and increased safety and cleaning requirements. In one study, K-12 teachers who reported more concerns about students and families also reported higher depression and anxiety (Herman et al., 2021). High stress and inadequate work supports result in lower quality teaching and support for students (Hamre & Pianta, 2004; Sandilos et al., 2015). Inequities facing students, families, and teachers in rural districts with fewer resources compound these stressors (Chen, 2022).

In summary, this project is designed to address the following national needs: (a) effective interventions for supporting young students' social-emotional development, addressing challenging behavior, and decreasing use of exclusionary discipline practices; (b) continuity of supports across PreK and K; (c) effective approaches to support teachers' use of *PM* practices; (d) targeted practices to provide effective social, emotional, and behavioral interventions for students affected by the COVID-19 pandemic; and (e) strategies for sustaining and scaling these

interventions within districts across the country. The partner districts indicate these needs are aligned with their strategic goals and priorities (letters of support; Appendix C).

A.2 Demonstration of Promising New Strategies

Innovative Model Combining Effective SEL Prevention and Promotion Practices with Coaching

The *PM* ([redacted] Ostrosky, & [redacted] 2021) is a multi-tiered framework of practices used by teachers to promote the social-emotional development of all students, prevent challenging behavior through targeted instruction for students at-risk, and provide intervention for students with persistent challenging behavior. *PM* practices are based on research on effective instruction (e.g., National Research Council, 2001), teacher-child relationships (e.g., Miller et al., 2017), family partnerships, strategies to promote engagement (e.g., Christopher & Farran, 2020), promotion of social-emotional skills (e.g., Domitrovich et al., 2012), and individualized behavior support interventions for students with severe behavior challenges (e.g., Blair et al., 2010). Coaching emphasizes the use of practices in a manner that recognizes how culture influences behavior and that culturally responsive practice is critical to supporting each learner in an equitable and anti-biased classroom (NAEYC, 2019; Steed et al., 2021).

The *PM* organizes evidence-based practices in promotion (tier 1), prevention (tier 2), and intervention (tier 3) tiers. The promotion tier (tier 1) includes practices intended to foster nurturing and responsive relationships with students, team members, and families; create a positive climate in the classroom; provide high-quality, supportive, and predictable environments; and promote social-emotional skills. The prevention tier (tier 2) emphasizes intentional instruction of social-emotional skills. Teachers are supported to use systematic and developmentally appropriate instruction on social-emotional skills with the precision, intensity, and frequency needed for students to be successful. At the intervention tier (tier 3), teachers are

guided to collaborate as team members in the development and implementation of an individualized behavior support plan, which is implemented by the teacher, other team members, and family members within daily activities and routines at school and home. When teachers implement the promotion and prevention practices, only a small number of students are likely to need more intensive support ([redacted] et al., 2021).

Professional Development to Support Implementation of the PM

The need for high-quality professional development (PD) is well documented (e.g., Institute of Medicine & National Research Council, 2015; Kraft et al., 2018), with consensus that to be effective, PD must be embedded in the classroom context and include targeted, systematic feedback about teacher-child interactions (Kraft et al., 2018). Research on PD for educators supports the combined use of workshop training and individualized coaching to improve classroom and instructional quality and student outcomes (Brunsek et al., 2020; Snyder et al., 2015); these are the core components of the *PM*'s PD model for teachers.

Teacher training. Training includes intensive workshops and classroom implementation materials to support teachers' use of *PM* practices. A recent meta-analysis of 60 studies found teachers benefitted from learning through group trainings and having instructional resources before beginning individualized coaching (Kraft et al., 2018). The *PM* developers drew from principles of adult learning to develop a series of small-group workshops delivered over three days (6 hours each) before implementing coaching. During the workshops, trainers describe *PM* practices using PowerPoint, videos, case studies, and handouts, and give teachers implementation guides and classroom implementation materials. There is a focus on implementing the practices equitably to ensure each child is receiving the support they need.

Practice-Based Coaching (PBC). Following workshops, district coaches provide support in

the classroom using PBC ([redacted] et al., 2016; Snyder et al., 2022). PBC is grounded in performance-based instructional models (e.g., Knight, 2007). PBC aligns with essential features of effective coaching identified in the literature such as individualized one-on-one, intensive, and sustained sessions that are context specific (Kraft et al., 2018). The PBC cycle includes three components: (a) strengths and needs assessment, goal setting and action planning; (b) focused observation; and (c) reflection and feedback. These components are implemented during weekly coaching visits. After each session, coaches complete logs to document coaching activities. PBC has been effectively used to support teachers' implementation of embedded instruction practices (Snyder et al., 2018), social-emotional teaching practices (e.g., [redacted] et al., 2016), and targeted behavior support strategies (e.g., Conroy et al., 2014, 2015).

Coach Training. Prior to our Mid-Phase EIR project, the coaches in our randomized trials were research staff ([redacted] et al., 2021; [redacted] et al., 2016). One of our scaling strategies in the Mid-Phase EIR project was to prepare district personnel to coach teachers to implement the *PM*. In that project, we developed the following procedures for training and supporting coaches: (a) training on the *PM*, the Teaching Pyramid Observation Tool (TPOT; [redacted] et al., 2014), and PBC; (b) biweekly coach support meetings; and (c) regular feedback based on coaches' interactions with teachers. These processes were tested and refined over the course of five years with input from district administrators, coaches, and teachers.

Evidence

The specific **promotion and prevention practices associated with the *PM*** have been implemented in different settings and consistently produce **medium to large, positive impacts** on student's social-emotional competence (effect sizes ranging from 0.22 to 0.42), challenging and disruptive behavior (effect sizes ranging from -0.18 to -0.42), and teacher-student

relationships (effect size of 0.26) – outcomes which are all associated with improved academic achievement and success. These impacts were seen in two prior randomized controlled trials (RCTs) of the *PM* ([redacted] et al., 2021; [redacted] et al., 2016) as well as two similar interventions (Hamre et al., 2012; Sutherland et al., 2018) that include the use of the promotion and prevention practices that are embedded in the *PM*. To date, there is **strong evidence that meets WWC and ESEA standards (see Evidence Form)**. In addition, studies on the *PM* have used a coaching model that leads to sustained and improved teacher practice; three of the four studies cited as evidence also used the PBC model proposed in this project.

Systematic reviews of social-emotional interventions (Luo et al., 2022) consistently find that classroom-wide interventions are more effective for students in PreK and K classrooms than for older students (January et al., 2011). In addition to the intervention studies that provide evidence for this grant, several empirical studies indicate that positive teacher-child relationships (Mashburn et al., 2008; Miller et al., 2017; O'Connor et al., 2011), supportive environments and explicit social-emotional teaching (Broekhuizen et al., 2016; Reicher, 2010), and teacher training and support (Hall, 2020; Hanno, 2021) can improve students' social-emotional competence and behavioral outcomes. Together, this evidence demonstrates that the proposed project which (a) trains and coaches PreK and K teachers to implement effective, classwide strategies to support social-emotional competence and (b) provides support for capacity-building and shared understanding among teachers, coaches, and administrative leadership is highly likely to lead to medium to large improvements in social-emotional and early learning outcomes.

A.3. Potential Contribution to Increased Knowledge

This project is designed to contribute to increasing the knowledge base in several significant ways. First, this project will demonstrate the effectiveness of a classwide intervention that can be

used across both PreK and K classrooms to promote each student's social-emotional development and prevent social, emotional, and behavioral delays that interfere with learning and development. Second, the *PM* is aligned across PreK and K to ensure a more successful transition for young children into formal schooling. This will be one of the first studies to examine the wide-scale use of a tiered social-emotional intervention model across PreK and K. Third, the project will provide information on how to use the *PM* to reduce the need for exclusionary discipline practices that impede student's development and learning. Finally, the project will demonstrate how the coaching model and the social-emotional intervention can be scaled, implemented, and sustained in school districts across the country.

B. Strategy to Scale

Our goal is to expand the use of the *PM* in diverse PreK and K classrooms settings across the US and to create mechanisms for sustaining and scaling the model. Our approach to scaling involves a focus on spreading and sustaining the use of the *PM* by working in partnership with districts to establish the implementation infrastructure for sustainability, ensuring the ownership and capacity of district personnel and systems for sustainability and scale-up (Coburn, 2003; Fagan et al, 2019; Hume & McIntosh, 2013; McIntosh et al., 2018). These closely aligned approaches provide theoretical and practical guidance on scaling interventions in schools.

B.1. Strategies to Address Barriers to Scale

Despite the promise of the *PM*, there are barriers to scaling the model within and across school districts. Because these challenges are common to educational interventions, our work in this area has implications for education more broadly (Mart et al., 2015).

Barrier 1: Insufficient training in promoting social-emotional competence and addressing challenging behaviors. Teachers identify addressing challenging behavior as a primary training

need and as a factor that interferes with the quality of the classroom environment and student engagement and learning. Across *PM* studies, pre-intervention data demonstrate that teachers' implementation of social-emotional teaching and behavior support practices are not sufficient for addressing the social, emotional, and behavioral needs of students in their classrooms. In addition, district administrators identify social-emotional and behavioral needs as a training priority. Further, teachers report that they do not consistently receive follow-up support in the classroom (Oliver et al., 2011; Kraft et al., 2018).

Solution 1A. Prepare district personnel to provide training and ongoing coaching to PreK and K teachers. We will identify and train district coaches to use the professional development (PD) model that we have successfully used in previous RCTs to support teachers in the RCT study. This model includes high-quality workshops, implementation guides and materials, and weekly PBC ([redacted] et al., 2016; Snyder et al., 2022). The PD model results in teachers' sustained use of the practices a year after coaching ends ([redacted] et al., 2021). In our Mid-Phase EIR project, we developed a process for training and supporting district-hired coaches. This process resulted in district coaches implementing the PD intervention with fidelity; PreK and K teachers subsequently implemented *PM* practices with fidelity. Project staff will use this approach to train and support district coaches to train teachers with fidelity. This approach involves training on the *PM* practices and use of PBC to support teachers to implement the practices with fidelity; ongoing support to ensure district coaches deliver PBC with fidelity, and technical assistance as the district scales-up to a new cohort of teachers. To support district coaches' fidelity, project staff will review videos and provide feedback. Staff will meet biweekly with coaches to address barriers and identify supports needed.

Solution 1B. Provide training and coaching to PreK and K teachers within districts. Project staff and district coaches together will deliver the *PM* workshops to PreK and K teachers. District coaches will then provide 16 coaching sessions to each teacher with support from project staff. In the year following the evaluation study (sustainability study), district coaches will train and coach teachers who were in the control condition during the RCT study year. It is possible they will also use PBC with non-study teachers which will provide further evidence of scaling.

Coburn (2003) emphasizes the importance of changing both practice and beliefs about the effectiveness of the practices. In one RCT ([redacted] et al., 2021), we followed teachers for a year after coaching and found teachers were using the *PM* practices at levels similar to levels observed at the end of intervention. In focus groups, teachers reported that the *PM*: (a) changed how they teach, (b) created a more positive climate in their classroom, (c) improved students' social skills and challenging behavior, and (d) gave them tools to address challenging behavior. These changes provide evidence of sustained implementation of the strategies.

Barrier 2: Competing priorities within districts resulting in a lack of ownership. A key barrier we encounter in our work is competing priorities and lack of ownership within districts for the *PM* work. The lack of ownership often results from competing demands, lack of resources, and unclear alignment with other priorities.

Solution 2A. Align PM with other initiatives. We have recruited districts that have social-emotional learning, challenging behavior, exclusionary discipline, or inequitable discipline practices in their strategic plan, goals and objectives, or ongoing initiatives. We will work with district staff to clarify the alignment between the *PM* and other initiatives. This will be critical to ensuring sustainability. The *PM* allows for adapted implementation of the core practices to tailor them to the classroom, school, or district context. Districts will have the data tools, professional

development materials, and coaching strategies to continue scale-up. Another important feature of the *PM* that will enhance successful expansion and scale-up is that it provides practices for use in a multi-tiered system of supports (MTSS; Carta & Young, 2019), school-wide positive behavior support ([redacted] et al., 2015), and school climate efforts. This alignment will enhance the likelihood of scaling within school districts that are implementing these frameworks in K-12.

Solution 2B. Use data to identify needs, monitor implementation and measure outcomes. Data-based decision making is a key factor in scaling and sustaining behavior support interventions (Hume & McIntosh, 2013; McIntosh, 2018). We will be working with districts to use *PM* data to monitor inputs and outcomes aligned with their strategic goals. For example, for our partner districts who have a goal to reduce the use of exclusionary discipline, we will guide them to monitor the suspension and expulsion rates, with a focus on monitoring disproportionality, as they implement the *PM*. Other potential sources of data are coaching dosage and fidelity, and teacher implementation data. Data will be used at the district level to monitor and improve coaching, make professional development decisions, monitor implementation, and monitor key outcomes. McIntosh et al. (2018), in a prospective study on sustained implementation of school-wide PBIS, found that adequate implementation fidelity and the use of data for decision-making were the strongest predictors for sustainability. In our partnership work with districts, we will provide them with tools and technical assistance on using their data to improve implementation fidelity and evaluate outcomes.

Barrier 3: Sustainability of teacher supports for implementation. A key component of high fidelity use of the *PM* is effective PD supports. While we have designed a process for training and supporting coaches within districts, it will be important to build systems that will scale and sustain those supports to all teachers within the districts.

Solution 3A. Align Professional Development (PD) supports. Each partner district has PD supports for teachers around social-emotional learning although the supports vary in intensity, dosage, and access. We will work with districts to develop a plan for delivering PD supports around *PM* such that it is integrated with current PD efforts. This will involve: (a) identifying PD resources and activities that currently exist for PreK and K teachers, (b) developing a process for determining what level of support individual teachers need, (c) matching PD supports to teacher's level of need, and (d) aligning PD efforts to ensure consistency of messaging. Alignment will streamline supports teachers receive so all supports/initiatives are manageable and connected rather than competing for a teacher's limited time. Further, this alignment can reduce duplication and increase the effectiveness of supports. During the RCT study year and the sustainability study year, project staff will provide support to district coaches. A key activity will be applying the steps above to ensuring the continued support for coaches.

Solution 3B. In a report by former EIR grantees, a recommendation was to plan for sustainability from day 1 by anticipating funding challenges (DeWire et al., 2017). Through our work on previous projects, we can estimate the costs for providing the teacher supports needed to implement *PM* practices. We will work with districts from day 1 to: (a) estimate costs associated with the *PM*, (b) evaluate existing resources within the district, and (c) link districts to networks of support. The networks of support will include: (a) the Pyramid Model Consortium (PMC) which is a nonprofit organization that provides training and ongoing support to states, communities, and districts, as they scale up the *PM,* and (b) state cross-sector leadership teams. The National Center for Pyramid Model Innovations (NCPMI) and PMC have facilitated leadership teams in over 35 states to support statewide scale up of the *PM.* The states involved in this project [redacted] *PM* Leadership Teams. Each state has developed a cadre of

trainers who can support *PM* implementation. Project staff will work with individual districts to connect with their state teams to further build their capacity for *PM* implementation over time.

B.2. Adequacy of the Management Plan

As described in section C-2, we have developed a set of goals, objectives, outcomes, and associated activities for the proposed project (see Table 1 in Appendix B). Based on this information and in collaboration with our Federal Project Officer, we will develop, and review monthly, a detailed management plan that includes milestones, performance metrics, and annual targets. We will employ a management-by-objectives system to systematically track implementation of objectives, activities, and outcomes. This system will be crucial for regularly and systematically communicating expectations, problems, or barriers, as well as ensuring accountability in conducting activities and producing deliverables. We will work with our Federal Project Officer on a regular basis to update progress and outcomes.

The project will be implemented by a team of highly qualified personnel with extensive experience on similar projects. Figure 1 (Appendix J) shows the management structure. The management team includes [redacted] (Vanderbilt); [redacted] (University of South Florida); and [redacted] and [redacted] (SRI). Vitas for each of these individuals are included in Appendix B, and descriptions of their roles are included in the budget narrative. [redacted] will lead the project and ensure all activities are conducted as proposed, manage the budget, and provide overall leadership. [redacted] will be the project director and will coordinate project activities. The leadership team will have two sub-teams: the implementation team ([redacted]) and the evaluation team ([redacted]). The implementation team will manage all activities related to implementation of the *PM* in districts and working with districts around sustainability. [redacted]

[redacted] have collaborated for over two decades on *PM* work and have worked in districts across the country. This work includes multiple RCTs; the development of the Teaching Pyramid Observation Tool (TPOT; [redacted] et al., 2014) including alignment with K classrooms; the development of training, coaching, and sustainability materials and processes; and establishing *PM* leadership teams. Finally, [redacted] will lead the independent evaluation. They have extensive experience conducting independent evaluations funded by the Department of Education's IES and OII offices, including designing and conducting RCTs in PreK and K settings that meet WWC standards with and without reservations, and are certified What Works Clearinghouse reviewers. The full management team will meet biweekly.

The implementation team (VU, USF) will meet with the district coordinator and sustainability teams regularly. These meetings will involve planning training and coaching activities, implementing sustainability plans and activities, and seeking input and feedback from district personnel. [redacted] will work collaboratively with the partner districts to ensure all goals and objectives are met. The VU Department of Special Education's budget staff will manage budget related matters. PMC and the *PM* state leadership teams will be important partners in working with districts to create a network of support for sustainability and scaling.

B.3. Capacity to Scale Project

The efficacy of the *PM* has been evaluated, and positive changes in classroom practices and students' social and behavioral outcomes have been observed. Developed and evaluated over 20 years, the *PM* is manualized with teacher and coach training materials, implementation materials, and an evidenced-based coaching model ([redacted] et al., 2016; Snyder et al., 2022) (see Table 2 in Appendix J). Initially developed for use in PreK classrooms, the *PM* and associated materials were expanded for use in K classrooms as part of a Mid-Phase EIR project. There are

eight elements of the *PM* that speak to the likelihood of success in this expansion effort. To accommodate a range of teacher preferences and needs, the training materials: (1) are available in print and web-based formats, (2) are available in English and Spanish, and (3) include videos of practitioners implementing the *PM* across diverse groups of students and teachers in PreK and K settings. To accommodate the use of different instructional approaches and curricula, (4) the *PM* has been used with fidelity in classrooms using various instructional approaches. To ensure that we are studying the *PM* as it is intended to be used, (5) we will use the *PM* fidelity tool, TPOT [redacted] The TPOT has undergone rigorous psychometric study and has excellent short-term test-retest reliability and internal consistency. ***It is important to note that all training materials are available at no cost on the NCPMI website.***

To ensure that practitioners reach implementation fidelity, (6) the *PM* developers have studied the use of PBC (Snyder et al., 2022) to support teachers' implementation of the *PM* (Artman-Meeker & [redacted], 2013; [redacted], [redacted] et al., 2021; [redacted] et al., 2016). To ensure individual coaches and teachers are provided with the support and guidance they need, the *PM* includes materials (7) that guide schools to make data-based decisions, scale-up and sustain the *PM* (Fox et al., 2016). Finally, the *PM* developers have established two entities (8) that will be key to the sustaining and scaling efforts of our participating districts: (a) The Pyramid Model Consortium (PMC), and (b) State *PM* leadership teams in over 35 states including the states where we will be working. These entities represent mechanisms for scaling, sustaining, and dissemination.

B.4. Mechanisms to Broadly Disseminate Project Information.

The Principal Investigators have a strong history of disseminating findings and products resulting from grant-funded research efforts. Dissemination efforts have included scholarly

publications, implementation fidelity tools (e.g., TPOT), a coaching framework (Practice-Based Coaching), and practitioner-oriented books (e.g., *Unpacking the Pyramid Model, Essentials of Practice-Based Coaching*). Because we will be working with school districts across the nation, we know there will be a varied audience interested in the findings (i.e., state and district leaders, trainers and school administrators, classroom teachers, coaches, school mental health consultants, researchers). We will leverage the infrastructure developed around the *PM* to expand the reach of our dissemination. All materials and processes developed through this project will be disseminated at no cost through the following entities: NCPMI, a federally-funded technical assistance center that disseminates fact sheets, training modules, data tools, implementation materials and state and school/program implementation guidance *at no cost* that reaches over 256,000 users; the PMC, which promotes high fidelity use of the *PM* through training dissemination; and the Network of State Leaders for *PM* Implementation (35 states), including the states of our partner districts. [redacted] are leaders in these organizations. The goal of our dissemination efforts is to ensure information gets to the appropriate audiences to ensure replication and scale-up efforts across the country.

State and District Leaders: (a) deliver presentations at national conferences; (b) develop state leader briefing reports and webinars on study results, cost-effectiveness analysis, and outcomes; and (c) disseminate implementation materials for use by state and regional technical assistance providers. *School Administrators and Practitioners:* (a) use NCPMI social media and website to post tips for guiding *PM* implementation in schools; (b) submit manuscripts on *PM* implementation and scale-up of *PM* implementation; (c) collaborate with partners to present at national conferences; and (d) disseminate *PM* materials about staff buy-in, family engagement, classroom coaching, and classroom implementation. *Researchers:* (a) submit proposals to

national research conferences, and (b) submit manuscripts to research journals on study outcomes, costs and implications of the cost-effectiveness analysis, and benefits/challenges in scaling up *PM* implementation in PreK and K classrooms to research journals.

C. Quality of Project Design

C.1 Conceptual Framework

The goal of this project is to expand the use of the *PM* in PreK and K classrooms with high needs students and to create mechanisms for sustaining and scaling the model. The logic model for meeting that goal is illustrated in Figure 1 (Appendix G) and includes a well-specified conceptual framework that identifies four core components: (1) training for coaches, (2) training for teachers, (3) implementing PBC, and (4) sustainability activities. First, to support the implementation and evaluation of the *PM* within each district, we will train district coaches to implement PBC with teachers. As they deliver coaching, we will provide them with support and feedback. As a result, coaches will deliver PBC with fidelity. Second, in collaboration with the district coaches, we will provide training to PreK and K teachers on *PM* practices. Third, district coaches will provide PBC to teachers who are assigned to the intervention condition. We expect that the teacher training and coaching activities will result in increases in teachers' use of social-emotional teaching and behavior support practices (proximal outcomes). We hypothesize that increased use of these practices will result in improvement in students' social-emotional competence, challenging behaviors, teacher-child interactions, and executive function skills, as well as early academic outcomes (short-term outcomes). There is theoretical support for the connection between behavior support interventions and academic outcomes (Madigan et al., 2016; Morris et al., 2013). As teachers gain skills in preventing challenging behavior, they spend more time engaging in interactions that promote social-emotional and academic outcomes.

The final core component is the use of sustainability processes to support long-term use of the *PM*. To ensure leader buy-in with *PM* implementation, we provide an orientation to the approach, a summary of evidence, and information related to sustainability. We will also provide capacity-building technical assistance to a district implementation team that will engage in data decision-making and establish the PD implementation infrastructure. Through these two activities, districts will have a plan for scaling and sustaining use of the *PM* (proximal outcome) that results in sustained support for all teachers in the districts to implement the *PM* beyond the project period (long term outcome). These activities are based on Coburn's work (2003).

C.2. Clearly Specified and Measurable Goals, Objectives, and Outcomes

Our overall project goal is to expand the use of the *PM* to PreK and K classrooms in diverse districts, evaluate the efficacy across districts, and to create mechanisms for sustaining and scaling the model across the country. To accomplish this goal, we have three subgoals and associated objectives. A detailed listing of the goals, objectives, timelines, and expected outcomes are listed in Table 1 in Appendix J and described below.

Goal 1: Work with districts to develop the infrastructure and capacity to remove barriers and support scaling of the PM *in PreK and K classrooms.*

Objective 1.1: As we have partnered with districts for this proposal, we have asked them to identify a district coordinator for this work. This person will be funded through the project, and part of the sustainability plan will be identifying mechanisms to support this person long term.

Objective 1.2: Prior to beginning the work outlined in the objectives, we will work with each district to develop a MOU that outlines goals, objectives, expected outcomes, and detailed budget information.

Objective 1.3: We will work with the district coordinator to identify a team of leaders (e.g., instructional leaders, budget leaders) who are key to sustaining *PM* implementation. This team will be referred to as the sustainability team.

Objective 1.4: As part of our Mid-Phase EIR project, we developed sustainability materials for district leaders and schools. These included an evidence-summary and presentation materials to gain school and district leader buy-in, information on sustaining the investment in PBC, guidance for providing ongoing professional development, and guidance for the use of data from implementation and outcome measures. We will revise these materials based on input from our district coordinators and sustainability teams to align with the strategic priorities of each district.

Objectives 1.5 and 1.6: The plans for overcoming barriers to scaling and sustainability are described in detail beginning on page 11.

Goal 2: Work with districts to prepare for, plan, and deliver implementation supports for PM *implementation in PreK and K Classrooms.* SRI will conduct an independent evaluation of the efficacy of the *PM* in PreK and K classrooms in 8 districts across the country. Classroom teachers will be randomly assigned to either a *PM* intervention condition or a delayed-intervention control condition. Teachers in the *PM* condition will receive training and coaching in the *PM* during the RCT study year, and teachers in the delayed intervention control condition will receive training and coaching in the sustainability study year.

Objective 2.1: One of the key implementation supports will be district-hired coaches who support teachers to implement the *PM* with fidelity. We will work with the district coordinator to identify staff who can assume these roles or hire new staff. The district will identify one coach for every six teachers who are participating in the evaluation. These coaches should have classroom experience, knowledge of the *PM*, and experience supporting teachers. While these

coaches will be paid out of project funds during the first two years, part of the sustainability plan will be determining how the coaches will be paid beyond the grant cycle.

Objective 2.2. We will conduct the following activities to train coaches: (a) provide training (2 days on the PBC and 1.5 days on using the TPOT); and (b) review audiotapes of the coaches working with teachers, score them for fidelity and provide feedback to the coaches. We will use existing materials that are available at no cost and lessons learned from earlier projects as well as our Mid-Phase EIR grant including: (a) a manualized training for coaches; (b) a process for supporting coaches as they support teachers; (c) materials for documenting coaching efforts; and (d) a classroom coach handbook that includes action plan materials, guidance for implementing coaching cycle components, and strategies for managing their coaching caseload.

Objective 2.3: During the RCT study year, project staff will lead the teacher training workshops in collaboration with district coaches. During the sustainability study year, district coaches will lead the teacher training workshops with support from project staff. The workshops will be three days, spread across time with each workshop focused on a different tier of the *PM*. These training materials have been developed and refined based on our previous work.

Objective 2.4: During the RCT study year, district coaches will provide 16 weeks of PBC to teachers in the intervention condition. Project staff will support the district coaches during biweekly meetings. These meetings will focus on identifying successes, discussing barriers and challenges, and offering suggestions. Project staff will lead these meetings during the RCT study year. During the sustainability study year, district coaches will provide PBC to the control teachers with assistance from project staff only as needed. They will also be encouraged to support non-study teachers during the sustainability study year.

Objective 2.5: To ensure coaches are implementing PBC with fidelity, coaches will audiotape their reflection and feedback meetings with teachers. Project staff will randomly sample audiotapes to score for fidelity to the model and provide supportive and constructive feedback to coaches. Staff will work with the district to identify a lead implementation coach who will be responsible for this support during the sustainability study.

Objective 2.6: Teacher implementation data (TPOT) will be collected during the sustainability study. These data will be collected in the intervention teachers' classrooms at the end of the sustainability study year to measure their continued use of PM practices without coaching. These data will be collected in the control teachers' classrooms in the fall and spring to measure changes in teacher implementation as a result of coaching conducted by district coaches.

Goal 3: To evaluate the impact of implementation of the PM *in PreK and K classrooms on students' social, behavioral, and early academic outcomes and understand differential impacts across populations and settings.* These procedures are described in detail in section D.

C.3 Design is Appropriate to Needs of Target Population

The *PM* addresses an urgent need to support PreK and K students in developing social-emotional competencies that will serve them in school and life. This will be particularly important for children with social-emotional or behavioral concerns resulting from the pandemic. The project also responds to a related and essential need for evidence-based PD for PreK and K teachers, to help them effectively support students' development of social-emotional skills (Brunsek et al., 2020). In addition to empirical findings showing positive student outcomes in our previous studies of the *PM*, teachers reported the practices were feasible, effective, and acceptable for use in their classrooms; the *PM* training was inspiring and practical; and PBC was essential to effective implementation of *PM* practices ([redacted] et al., 2021; [redacted] et

al., 2016). With limited resources to invest in PD (Sheridan et al., 2009), public schools need an effective, evidence-based intervention administered by district staff. Findings from a large-scale evaluation of the *PM* across PreK and K classrooms in districts around the country could demonstrate the capacity of schools to support teachers to deliver impactful interventions, nurturing all students' social-emotional competence, and reducing challenging behaviors. The proposed project will address the sustainability of teachers' practices after receiving coaching supports and will support districts to develop a plan for sustained implementation of the *PM*. Given that the barriers to scaling the *PM* are like barriers to scaling other educational interventions, this work will inform the field in general.

D. Quality of the Project Evaluation

D.1 Evaluation Methods that Meet WWC Evidence Standards Without Reservations

SRI International will conduct an independent evaluation of the *PM* to evaluate the implementation and impact on students' social-emotional competence, challenging behaviors, early academic skills, and teacher-child interactions in PreK and K classrooms. In the proposed study, SRI will implement a teacher-level cluster RCT and collect direct assessments, teacher ratings, and observations of students as well as independent observations of teacher practices.

Evaluation questions. SRI will address four confirmatory impact research questions: relative to students in control classrooms, does the *PM* impact students' (1) social skills, (2) challenging behaviors, (3) teacher-child interactions, and (4) academic skills? SRI will also address the following exploratory student impact questions: (5) Relative to students in control classrooms, does the *PM* impact students' executive function skills? (6) Do the effects of the *PM* on student outcomes vary as a function of student and classroom characteristics? Finally, we will address questions related to fidelity of implementation and scaling: (7) Do the scaling strategies

lead to fidelity of *PM* implementation? (7a) Are district-hired coaches able to reach fidelity of Practice-Based Coaching supports across the school year? (7b) Compared with control teachers, to what extent do *PM* teachers demonstrate improvement in their positive SEL practices and reductions in exclusionary practices? (8) Does implementation fidelity relate to student outcomes? (9) What is the cost-effectiveness of scaling *PM*?

Design. In the proposed evaluation, SRI will implement a large, multisite cluster RCT drawing a sample from four geographically diverse states. Across three cohorts, SRI will work with up to eight high-needs districts (see letters of support in Appendix C) , 200 PreK and K teachers, and approximately 2,000 PreK and K students. Table 3 shows the number of classrooms and students by district and by cohort. Within districts, SRI will block by school, cohort, and grade level and randomly assign teachers to the *PM* or to a delayed intervention control condition (control). In the RCT study year, SRI will work with participating teachers to distribute consent forms to the parents/caregivers of all entering PreK and K students in study classrooms to obtain parent permission to participate in the study. SRI will sample at least 12 students per classroom, yielding a final projected sample of 1,200 treatment and 1,200 control group students at baseline, and approximately 1,000 treatment and 1,000 control group students with outcome data. SRI will collect teacher and parent consents and baseline data before randomly assigning teachers to condition. Control teachers will receive *PM* training and coaching the following year as part of the sustainability study. The evaluation team will track attrition at the teacher and student levels and employ steps to minimize attrition where possible. Regardless of attrition rates, we will examine the equivalence of the intervention and control classrooms at baseline to assess the extent to which randomization resulted in statistically equivalent groups. Thus, the study is designed to meet WWC without reservations.

Table 3. Projected Sample Sizes, by State, School District and Treatment Condition

	State and Districts # treatment / # control								Total
School Year	**2023-24**		**2024-25**				**2025-26**		
State	**[redacted] D1**	**[redacted] D2**	**[redacted] D1**	**[redacted] D2**	**[redacted] D1**	**[redacted] D2**	**[redacted] D1**	**[redacted] D2**	**N = 8**
Classrooms	20/20	5/5	20/20	5/5	20/20	5/5	20/20	5/5	100/100
Students	200/200	50/50	200/200	50/50	200/200	50/50	200/200	50/50	1000/1000

Note: [redacted]

Minimum detectable effect size (MDES) for student and teacher outcomes. SRI conducted a power analysis to calculate the effect of the *PM* on student outcomes based on a two-level (students nested in teachers) cluster RCT with treatment at the teacher level using PowerUp (Dong & Maynard, 2013). Assuming 200 teachers (J) divided equally between intervention and comparison conditions (P = 0.5), 10 students per teacher with parental consent and with outcome data, a Type II error rate of 20% (β = .20), a study-wide Type I error rate of 5% for two-tailed tests of condition, a teacher-level ICC of .10, and proportion of variance in Level 2 outcome explained by Level 1 covariates and Level 2 covariates are both .49, the MDES for student outcomes is 0.12 and the MDES for teacher outcome is 0.43.

D.2. Guidance About Effective Strategies Suitable for Replication

SRI will collect data on the aspects of implementation that are central to the replication or expansion of the *PM*. In alignment with the logic model (Appendix G), we have identified the core aspects of implementation as: (a) training district coaches on the *PM* and how to implement PBC with fidelity; (b) training teachers to implement *PM* practices with fidelity and to limit use of counterproductive strategies (i.e., those identified as red flags on the TPOT); (c) providing

ongoing support through PBC to improve and increase *PM* practices that result in social-emotional skill development among students in PreK and K classrooms; and (d) administrative supports, materials, and processes that result in sustainability of practices. The study of how these core components are implemented will be integrated into the RCT data collection methods and timeline. Using the fidelity of implementation matrix developed as part of the Mid-Phase EIR grant and refined to include aspects of scale-up and expansion that are important to measure, SRI will examine the level of fidelity of implementation to *PM* practices that are needed to produce positive changes in teacher practices and student outcomes. The matrix will specify a priori thresholds for low, adequate, and high fidelity for each of the core components. In addition, we will elucidate the usability and feasibility of the *PM* when its coaching components are delivered by district coaches and determine what factors are associated with higher (or lower) fidelity and the likelihood of scalability. Together, these data – collected across at least 4 states and up to 8 diverse districts – will provide critical information about implementation facilitators and challenges that will enable replication within and across districts in different states.

Fidelity of Implementation of *PM* Components. We will collect data on the fidelity of training for district coaches and how well the coaches implement PBC. We will monitor adherence and quality of teacher training workshops and PBC training activities using checklists implemented in prior efficacy studies. District coaches will use a rigorous process to coach teachers to implement *PM* practices with fidelity. To assess district coaches' fidelity to PBC, project staff will assess audiotapes of the first four coaching sessions for each coach and 25% of the subsequent sessions, providing support and feedback on PBC implementation to the district coaches. We will assess coaches' adherence to the PBC model and quality of PBC implementation with coaching logs completed in all sessions, indicating the extent to which

sessions included PBC components and the dosage and quality of coach-to-teacher feedback. We will gather qualitative data on coaches' perceptions of implementation during interviews.

We will use the TPOT to rate the extent to which teachers in both conditions implement the *PM* practices. The TPOT is an observation too for measuring adherence and quality of implementation of PM practices ([redacted] et al., 2014). Coaches refer to TPOT data when providing feedback to teachers about *PM* implementation, consistent with how efficacy studies have ensured treatment fidelity (O'Donnell, 2008). We will ask teachers to complete the Teachers' Additional Experiences Questionnaire (TAEQ; [redacted] et al., 2016). This questionnaire provides data on teachers' use of other practices related to supporting social competence and addressing challenging behavior. Teachers will complete the TAEQ in the RCT study year and in the sustainability study year. Finally, we will interview teachers about their experiences implementing *PM* practices and engaging in coaching. The VU team will work closely with district leaders, coaches, and teachers to identify district factors that support fidelity of PBC. SRI will explore variation in implementation by district, social context, and participant characteristics. This includes differences by urbanicity (i.e., large urban versus small rural), school poverty, and child characteristics such as dual language learner status. The evaluation team will produce descriptive profiles of the association between variation in implementation by district, and teacher and student outcomes. Finally, we will collect cost data and conduct cost-effectiveness analysis to support replication of the *PM* in other districts and states.

D.3. Clearly Articulated Key Project Components, Mediators, and Outcomes

Performance Data and Outcomes

SRI will collect data on how project components are implemented, teacher and student outcomes, and the extent to which *PM* implementation mediates those outcomes. SRI will

implement a range of data collection strategies from multiple informants – student assessments, direct observations, and teacher reports of child outcomes. Teacher report measures will be collected via a secure online survey the team regularly uses for research studies. Direct observations will be collected by a team of local data collectors who will attend trainings and be required to pass strict certification and reliability before completing study assessments. The evaluation team will hire, train, and oversee the direct assessment data collection with a group of local experienced field assessors who will be masked to the status of the teacher assignment.

Teacher Implementation Measure. The Teaching Pyramid Observation Tool (TPOT; [redacted] et al., 2014) will be administered in the fall and spring of the RCT and the sustainability study. The TPOT measures adherence to and quality of implementation of *PM* practices and is sensitive to changes in teachers' use of *PM* practices (Snyder et al., 2011). Results of a G-study showed minimal error variance (i.e., 5%) attributed to occasions and raters and the Generalizability coefficient was .97. We have aligned the TPOT with Kindergarten classrooms in our Mid-Phase study.

Student outcome measures. We selected student outcome measures for their well-established reliability and validity for PreK and K students, sensitivity to change, appropriateness for diverse populations of students, and availability to be administered in Spanish. SRI will collect all measures at both baseline and post-intervention during each cohort's RCT study year.

Social skills and challenging behaviors. SRI will collect information about students' social-emotional competence using the teacher-reported Social Skills Improvement System (SSIS; Gresham & Elliott, 2008). Teachers report on two domains: social skills and problem behaviors. The SSIS is widely used and highly reliable, with internal consistency coefficients over .90 for both subscales (Gresham & Elliott, 2008).

Teacher-child interactions. SRI will collect information about the prevalence of positive teacher-student interactions using the ***Individualized Classroom Assessment Scoring System*** (inCLASS; Downer et al., 2011). The inCLASS measures students' interactions in classrooms with teachers, peers, and tasks. Studies have reported high inter-rater reliability (coders were within one point of each other 87% of the time), construct and criterion validity (Downer et al., 2010), and predicts school readiness in preschool students (Williford et al., 2013).

Academic Skills. SRI will examine students' early academic skills using the Academic Rating Scale (ARS; Rock & Pollack, 2002) which includes teacher report on students' academic achievement in three domains: language and literacy, general knowledge, and mathematical thinking. Studies have found evidence of high reliability for the ARS, with internal consistency coefficients ranging from .92 to .95 (Tourangeau et al., 2006). The ARS also correlates highly with measures of social competence in early childhood (Walker & Henderson, 2012).

Executive function skills. SRI will assess students' executive function skills using ***Peg Tapping*** (Diamond & Taylor, 1996) and ***Head-Toes-Knees-Shoulders*** tasks (HTKS; McClelland et al., 2014). Both Peg Tapping and HTKS assess students' inhibitory control. Studies have found internal consistency coefficients for Peg Tapping ranging from .75 to .82 and test-retest reliability coefficients of .80 (Meador et al., 2013). Peg Tapping scores predict academic skills in PreK and K students (Blair & Razza, 2007). Studies have found internal consistency coefficients for HTKS ranging from .92-.94 and test-retest reliability coefficients of .60 (Bailey et al., 2018). HTKS correlates with parent- and teacher-reported measures of attention and inhibition, and scores predict kindergarten math skills (Ponitz et al., 2009).

Planned Data Analysis and Thresholds

Minimize Attrition. Based on success in prior *PM* studies in minimizing overall and

differential attrition (e.g., [redacted], [redacted] et al., 2021; [redacted] et al., 2016), we expect that there will be no attrition at the school level, and teacher level attrition will be small and balanced across conditions. SRI will regularly monitor attrition rates across groups, examine whether pretest and posttest measures differ between those who attrite and those who do not, and take corrective action to reduce attrition. We will use engagement techniques (e.g., communicating frequently with teachers and administrators; providing stipends for teacher participation) to minimize attrition. We have maintained commitments with schools after random assignment in previous studies by building rapport and nurturing participant relationships, particularly with comparison groups, throughout the study's duration.

Examining Group Equivalence. Before conducting the impact analyses, SRI will test for baseline equivalence based on the Intent-To-Treat (ITT) assignments (i.e., group membership determined by initial assignment, regardless of later adherence).

Analysis of student outcomes (SSIS, ARS, inCLASS, Peg Tapping, HTKS; RQs 1-5): Because of the nested structure of the data, SRI will use hierarchical linear modeling (HLM) to adjust for the biased regression coefficient and variance component estimates that can result from correlated error structures in clustered data (Kim & Frees, 2006). SRI will conduct two-level HLM models (students nested in teachers) to estimate treatment impacts. The treatment effect will be estimated at the teacher level, the unit of randomization. We will include student baseline scores and other covariates to reduce residual error and increase power. The models will take the following form at the student level: $Y_{jk} = \beta_{0k} + \beta_{1k}Cov_{jk} + r_{jk}$, where Y_{jk} is the outcome score for student j in teacher k; β_{0k} is the covariate-adjusted intercept for teacher k; Cov_{jk} is a vector of student baseline scores and demographic characteristics, and r_{jk} is a student-specific error term. The models will take the following form at the teacher level: $\beta_{0k} = \gamma_{00} +$

$\gamma_{01}PM_k + \gamma_{02}T_k + \gamma_{03}B_k + u_{0k}$, where γ_{00} is the overall mean intercept across teachers, PM_k is a binary indicator for assignment to the PM, γ_{03} is the main effect of the intervention on student outcomes, T_k is a vector of teacher-level baseline characteristics, B_k is a set of fixed effects for the randomization blocks (schools, cohorts, and grade), and u_{0k} is a teacher-specific error term.

When applicable, SRI will adjust the estimated treatment effect *p*-values to account for multiple outcome measures from the same domain (WWC, 2020). SRI will apply the Benjamini and Hochberg (1995) approach, as extended to dependent measures (Benjamini & Yekutieli, 2001) within separate domains using the approach presented by Thissen and colleagues (2002).

Subgroup and moderation analysis (RQ 6). To examine the extent to which student (e.g., gender, race/ethnicity, home language), teacher (e.g., education, years teaching), and school (e.g., percent free and reduced-price lunch) characteristics moderate *PM* impacts, we will add within- and cross-level intervention-by-covariate interaction terms to the HLM specified above.

Analysis of teacher outcomes (TPOT; RQ 7): SRI will use analysis of covariance (ANCOVA) to estimate differences between *PM* and control teachers at posttest controlling for baseline scores on the same measure and other teacher demographic characteristics. The models will take the following form: $\boldsymbol{Y_k = \beta_0 + \beta_1 PM_k + \beta_k Cov_k + r_k}$, where Y_k is the teacher outcome; $\boldsymbol{PM_k}$ is a binary intervention indicator; $\boldsymbol{\beta_1}$ is the main effect of the *PM* on teacher outcomes; $\boldsymbol{Cov_k}$ is a vector of TPOT scores at baseline, randomization blocks, and demographic characteristics; and $\boldsymbol{r_k}$ is a teacher-specific error term.

Linking implementation to child outcomes (RQ 8). To describe the association between implementation of *PM* practices (TPOT) and student outcomes, we will add treatment-by-TPOT interaction terms to the student outcomes HLM specified above.

Cost effectiveness analysis (CEA; RQ9). The proposed RCT of the *PM* presents the opportunity to determine the program's cost effectiveness. Through analyses that compare the cost of the program to achieved student outcomes (improved social skills, decreased problem behavior, improved academic learning, and improved teacher-child interactions) on a per unit basis, this evaluation can provide policy-makers with information upon which to make decisions regarding the allocation of resources, which in turn will affect program sustainability. SRI proposes to conduct a cost effectiveness study to evaluate the benefit of the proposed interventions against the costs associated with the investment in these interventions. For both the treatment and control groups, SRI will collect cost information using the ingredients method which involves identifying ingredients, valuing, and pricing them, and analyzing their costs in informative ways for stakeholders (Levin et al., 2017).

SRI will identify each program input through a review of program documents. Project staff will work with districts to leverage existing databases or reports to understand and document site-based variations in implementation and costs. Based on these data, SRI will define a master list of program components, or ingredients, from which to determine costs. Using data collected from districts, publicly available data, and resources such as the "Cost Out" tool developed by Columbia's Teachers College, SRI analysts will determine the value of resources required for implementation. CE ratios will compare the cost of program inputs to student level outcomes that can be achieved for those costs. To inform policy decisions, the CE ratio for the *PM* will be compared to the CE ratio for business as usual, or the control group. Finally, districts will be connected to networks of support (PMC, NCPMI) and other districts to consider different funding mechanisms available to implement *PM* in a cost-effective way.

D.4. Methods will provide performance feedback and permit assessment of progress

We will implement several procedures to ensure ongoing feedback and continuous improvement in the project's operations. First, as described above, we will employ a management-by-objectives system to systematically track the implementation of objectives, activities, and outcomes. This system will be crucial for regularly and systematically communicating expectations, problems or barriers, and unforeseen opportunities, as well as ensuring accountability in conducting activities and producing deliverables. Second, we have included in our key personnel a research lead ([redacted]) who will provide ongoing feedback on project activities based on relevant data. Third, we will collect ongoing fidelity data on the teachers and coaches to ensure that practices are being implemented with fidelity and to provide feedback when practices fall below acceptable fidelity levels. Fourth, our external evaluators will provide interim data that will be used to guide our efforts in subsequent years. Finally, each district will have a sustainability team that will be called upon to provide input and recommendations on a regular basis. As we work with district sustainability teams, we will seek input from them on materials and processes and how to best align the *PM* work with other strategic priorities. There are additional mechanisms that will add significantly to the feedback and improvement processes: (a) ongoing meetings with the project officer; (b) refinement of materials with review and input from PreK and K teachers and administrators; (c) systematic review of evaluation data; and (d) annual reports and frequent exchanges of information to the funder.