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Making connections for children and teachers: using classroom-based implementation supports for teaching Pyramid Model practices in Head Start programs

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Introduction: In partnership with an urban school district Head Start program, we created a set of intervention supports that built upon the strengths of the district program services already in place.

Methods: We conducted a randomized control trial to test the use of natural helpers (teachers, special education coaches, and curriculum specialists) participating in practice-based coaching and monthly communities of practice, to augment a districtwide universal social-emotional program, The Pyramid Model for Promoting Social and Emotional Competence in Infants and Young Children. Participants included 53 preschool teachers and 519 preschool children, across 26 classrooms, and 9 schools in a high poverty area of the district. Teachers were randomized to a waitlist control or intervention condition. Intervention teachers participated in practice-based coaching and monthly communities of practice over the course of two years.

Results: Significant effects were found on participating intervention teachers' observed increased implementation of positive social-emotional practices in the classroom, decreases in red flags (observed teaching behaviors counter to the Pyramid Model), and increased teacher reports of self-efficacy in the intervention group, compared to control teachers. No significant impacts on child classroom behavior problems, self-regulation, or approaches to learning skills were found for children enrolled in intervention classrooms, compared to children in the control classrooms.

Discussion: Future directions for research and implications for practice are discussed.

KEYWORDS

Pyramid Model, social-emotional intervention, implementation, teacher practices, coaching, community of practice, Head Start

1 Introduction

Preschoolers entering early childhood classrooms with difficulty regulating their emotions, attention, and behavior often display challenging behaviors (Fantuzzo et al., 2005). Challenging behaviors such as disruptive, defiant, or socially withdrawn behavior can interfere with successful engagement with learning tasks and positive relationships with peers and teachers that support kindergarten readiness skills (Rimm-Kaufman et al., 2000; Williford et al., 2018). Young children living in low-income families are disproportionately exposed to contextual risk factors that increase their risk for behavior problems, compared to children living in middle- or higher-income families. Low-income children are more likely to experience food insecurity and malnutrition, inadequate housing, community and gun violence, and limited access to high quality early care and education programs (Kids Count Data Center, 2019; National Academies of Sciences, Engineering, and Medicine, 2019). Despite the need, only 2.5% of preschool aged children receive mental health support in early childhood programs (Loomis, 2018).

Challenging behaviors also place undue stress on early childhood teachers, particularly in under-resourced schools, where there may be few supports for teachers to address behavior within the classroom. Without formal professional development support such as mental health consultation, research suggests that early childhood teachers are not well equipped to implement effective strategies to address challenging behaviors, leading to an increased risk of child expulsion from the program (Clayback and Hemmeter, 2021; Gilliam and Shahar, 2006; Hemmeter et al., 2021).

Early childhood programs, such as Head Start, have an opportunity to prevent and address challenging behavior and to promote children's positive social-emotional and academic development in the long-term (García et al., 2023). Preschool teachers are a natural resource to promote social emotional skills of young children (Bulotsky-Shearer et al., 2020). Over the past decade, early childhood programs such as the federal Head Start program in the U.S. have increasingly invested in teacher professional development programs such as infant early childhood mental health consultation models (Gilliam et al., 2016) or practice-based coaching (Snyder, 2022; Snyder et al., 2015) focused on supporting children's social-emotional skills and reducing challenging behavior.

The Pyramid Model for Promoting Social-Emotional Competence in Infants and Young Children (Pyramid Model) is a multi-tiered, data-driven system of supports developed by the National Center for Pyramid Model Innovations, n.d., for typically developing children and children with disabilities, birth to five (Hemmeter et al., 2006). The Pyramid Model practices are widely disseminated nationally in the U.S. The framework includes a program-wide approach, which shows evidence of positive effects on teachers and children, when implemented to fidelity (Hemmeter et al., 2022, 2016). Positive changes in teachers' classroom practice are strengthened through several mechanisms, including embedded professional development supports such as practice-based coaching, classroom consultation, and program-wide administrative supports especially when implementation is scaled up (Hemmeter et al., 2022).

However, in practice implementing the Pyramid Model requires extensive resources; and there is a gap between availability of evidence-based strategies and classroom-based implementation (Durlak and DuPre, 2008). Often in large programs teachers receive information about evidence-based social-emotional strategies through traditional professional development workshops. Providing strategies and knowledge solely through traditional stand-alone didactic workshops is not enough to support teachers' consistent and effective implementation of strategies that decrease challenging behavior (Nisar et al., 2022). Embedded professional development supports, such as practice-based coaching and peer support, are critical mechanisms to alleviate teacher stress and facilitate implementation of effective evidence-based classroom strategies (Hemmeter et al., 2016; Snyder et al., 2015).

To address this need, the purpose of the current study was to develop, implement and test an intervention to promote children's social-emotional development and reduce challenging behavior. The project was aligned with a district initiative focused on improving the social and educational outcomes of children in schools located in a historically marginalized, geographic area, where 53% of children under eight lived below the federal poverty line and the rate of children passing the state kindergarten readiness test was below the state average (blinded for review). We developed and tested through a small, randomized control trial the effects of two intervention supports (practice-based coaching and teacher communities of practice) with the goal to strengthen program-wide implementation in the district program. Our intention was to build upon the strengths of the program already in place and to study the effects of teachers participating in these supports in schools where children were experiencing a high level of risk to their short- and long-term social-emotional and academic success. The district program had adopted the Pyramid Model framework across all preschool (ages 3–5) classrooms. Each year during our study, the district provided all teachers with a 2-day introduction to the model as well as a toolkit of resources to use in the classroom. In the short-term, we hoped our research collaboration would increase the uptake of classroom implementation of the Pyramid Model strategies with the addition of practice-based coaching and teacher communities of practice. In the longer-term, we hope teachers' participation would lead to measurable and sustainable impact on teacher practices promoting children's social-emotional development as a foundation for early school success.

We had two specific research questions: First, what is the effect of participating in the district-provided Pyramid Model professional development training with participating in intervention support (practice-based coaching and peer communities of practice) on teachers' implementation of positive social-emotional teaching practices, observed red flags (teaching practices incongruent with Pyramid Model practices), and self-reported feelings of self-efficacy? Second, what is the effect of teachers' participation in the offered Pyramid Model training with implementation support on children's classroom emotional and behavioral adjustment, self-regulation, and approaches to learning outcomes? We expected that teachers assigned to the intervention condition who participated in on-going support through practice-based coaching and peer communities of practice, would increase

their use of classroom social-emotional teaching strategies, reduce their use of red flag behaviors, and increase their self-efficacy over time compared to the control condition. We predicted that participating in practice-based coaching and peer communities of practice would directly improve teachers' self-efficacy related to classroom behavior management. In addition, we expected that children enrolled in classrooms in the intervention condition would show decreases in behavior problems and increases in self-regulation and approaches to learning as compared to children in classrooms in the control condition. Below, we provide a review of the relevant literature to support the proposed study.

2 Literature

2.1 Implementation of Pyramid Model practices

The Pyramid Model for Promoting Social and Emotional Competence in Infants and Young Children uses a tiered public health approach and provides a framework of evidence-based practices to promote young children's healthy social emotional development that can be used in conjunction with existing early childhood curricula (National Center for Pyramid Model Innovations, n.d.). To ensure that an effective workforce is in place, a primary element of the Pyramid Model is evidence-based adult learning practices within in-service and embedded professional development training that can support teachers adopting evidence-based strategies in the classroom (Dunst et al., 2015; Merriam, 2008).

When the Pyramid Model practices are implemented to fidelity, teachers' use of effective classroom social-emotional strategies and responsive teaching practices, lead to changes in children's social-emotional skills and reduction in disruptive behavior problems (Fox et al., 2014; Hemmeter et al., 2021; Hemmeter et al., 2016). In addition, implementation of the Pyramid Model practices are associated with decreased use of exclusionary discipline, improved family engagement, and inclusion of children with disabilities (Fox and Hemmeter, 2009; Fox et al., 2021; Hemmeter et al., 2022).

The first tier of the Pyramid Model focuses on *universal promotion* of teaching practices aimed at reducing challenging behaviors and promoting social competence for all children in the classroom. This tier focuses on providing nurturing and responsive relationships and creating supportive classroom environments. Tier two focuses on *secondary prevention* using intentional instruction of social skills, including emotional regulation, emotional vocabulary, social problem-solving, and friendship skills (Fox and Lentini, 2006). Tier three includes *tertiary interventions* intended to capture children who have not responded to tier one and two practices. Tier three strategies include determining the function of behavior, designing and implementing an individualized behavior plan that includes prevention, teaching of new skills, and new responses (Fox et al., 2002). Universal promotion of teaching practices can address most classroom behaviors that challenge adults and address the social-emotional needs of young children; secondary and tertiary strategies can meet the needs of young children who require more targeted or intensive support. Training teachers to implement Pyramid Model practices strengthens their ability to provide mental health support to students in early childhood education contexts. When training supports are provided that lead to higher fidelity of implementation by teachers, this fully maximizes their position as a natural resource for young children.

2.2 Pyramid Model implementation support through practice-based coaching

Practice-based coaching is often used to build teacher knowledge, strengthen skills, and provide training and mentoring. Practice-based coaching is defined as a collaborative partnership between the teacher and coach and consists of cycles focused on an explicit set of instructional practices, starting with shared goals and action planning, focused observations, reflection and feedback (Snyder, 2022; Snyder et al., 2015). Coaching includes opportunities for teachers to authentically practice classroom skills, teacher reflection on practices, and follow up support, such as observation and performance feedback from a trusted coach (Dunst, 2015).

Practice-based coaching increases teachers' classroom implementation of Pyramid Model practices. For example, in a 2015 study, Hemmeter and colleagues found that professional development consisting of observation, followed by goal setting, with performance feedback resulted in teachers' adoption and maintenance of Pyramid Model practices (Hemmeter et al., 2015). Hemmeter et al. (2016) in a randomized control efficacy study, demonstrated that practice-based coaching led to teachers' use of Pyramid Model practices with fidelity. Teachers in the intervention group received professional development consisting of small group workshops with guides and materials, while teachers in the control group received workshops following data collection. Teachers in the intervention group then received individual practice-based coaching. Teachers who received the intervention improved their implementation of Pyramid Model practices compared to teachers in the control group (Hemmeter et al., 2016). In another smaller study conducted in Head Start classrooms, three teachers received weekly classroom observations and were emailed feedback, to reflect on and incorporate in their classroom implementation of Pyramid Model strategies. All three teachers increased their use of Pyramid Model practices (Baughan et al., 2019) at the end of the study.

An important factor related to effective implementation is whether coaching is provided by someone familiar to teachers within the school system, or an outside professional. Research suggests that coaching provided by internal coaches is more effective on teachers' implementation of tier one Pyramid Model practices. In one study, internal coaches were classroom teachers. The researchers took on the role of external coaches and were only onsite during the coaching activities (Giordano et al., 2021). In another study examining the effects of peer coaching, researchers found that reciprocal peer coaching (teachers observing and providing feedback to one another) was effective in promoting teachers' use of selected Pyramid Model practices, which was maintained following removal of coaching (Golden et al., 2021). Another study looked at the effects of a tiered coaching model which included individual 'expert' coaching, small group coaching,

and self-guided coaching. Participants were assigned to a coaching condition individualized based on profiles of observed classroom practices, individual characteristics, and coaching preferences. Findings indicated that teachers in all conditions increased their use of Pyramid Model practices (Artman-Meeker et al., 2022). Finally, a training plus practice-based coaching implemented via text messaging was evaluated to determine if this was a viable model of implementation. Findings indicated that the training plus text message practice-based coaching was effective in supporting increased use of Pyramid Model practices by teachers (Golden et al., 2024). Overall, the inclusion of practice-based coaching by trusted professionals within the early childhood program is a critical training support for effective interventions aiming to improve teachers' implementation of Pyramid Model practices.

2.3 Pyramid Model implementation support through communities of practice

Communities of Practice (CoPs; sometimes called teacher learning communities) are a type of informal professional peer learning opportunity (Lave and Wenger, 1991; Lave and Wenger, 2017; Wenger, 1998) that have their roots in the healthcare sector (Li et al., 2009). CoPs are grounded in social or situated learning theory, which posits that learning occurs through observation, imitation, and modeling within a social system (Wenger, 2009). As such, people can learn from a variety of individuals, including their professional peers to co-construct knowledge rather than relying on experts (Hoadley, 2012; Lave and Wenger, 2017). CoPs offer the opportunity for adults to learn from each other by mutual engagement in real-life problem-solving around current issues (Hoadley, 2012; Lave and Wenger, 2017). Recently, CoPs have been evaluated with randomized control trials in the healthcare field (e.g., Olson et al., 2023; Perestelo-Pérez et al., 2024), demonstrating their effectiveness for bringing about changes in adult behaviors. However, the use of CoPs as part of research on the implementation of the Pyramid Model has not been widely documented, making this study an important first step in applying this mechanism of intervention in early childhood programs.

There are few studies that have examined the effects of teachers participating in CoPs related to social-emotional programs on teacher or child outcomes. While there is substantial literature describing the implementation of CoPs, there is little evidence to yet support the effectiveness of this mode of professional development specific to the use of evidence-based practices by teachers (Abigail, 2016). However, there is some evidence for the effectiveness of professional CoPs for teachers broadly within education. For example, a limited number of studies have examined interventions focused on instructional practices with elementary school-aged children and found some evidence of impacts on teacher and child outcomes (Nisar et al., 2022; Vescio et al., 2008). In a voluntary preschool program initiative, Wang et al. (2015) found that participating in professional CoPs improved teacher implementation of the intervention, school-wide feelings of support and collegiality, and engagement in leadership roles (Wang et al., 2015). In a review of the literature, learning communities, like CoPs, increased teacher collaboration with a focus on student learning, and improved student achievement scores over time (Vescio et al., 2008).

In addition, CoPs have been associated with increased teacher self-efficacy for using new practices (Hawkman et al., 2019; Inel Ekici, 2018; Kelley et al., 2020; Schwarzhaupt et al., 2021). Teacher self-efficacy is a psychological construct that depicts teachers' perceived ability to manage challenging situations, achieve personal goals, and as such positively influence young children's learning (Lazarides and Warner, 2020). Teacher self-efficacy is associated with increases in teachers' organization, motivation, goal setting, and persistence in using new practices (Bandura and Wessels, 1997; Goddard et al., 2004; Tschannen-Moran and Hoy, 2001, 2007). There is some evidence that increases in teacher self-efficacy can lead to more positive outcomes for children (Guo et al., 2012; Perera and John, 2020). In summary, while CoPs are widely adopted in education as embedded peer support and learning for teachers, their effectiveness in changing teacher behavior or feelings of self-efficacy, is rarely empirically evaluated. Therefore, we examined the effectiveness of this embedded support for Pyramid Model implementation in our project.

2.4 Implementation of the Pyramid Model and child outcomes

Most research to date has focused on changes in teacher outcomes, such as classroom practices, in the implementation of the Pyramid Model; however, a growing number of early childhood studies examine the Pyramid Model's effects on children's social-emotional, behavioral, and developmental skills. Findings are mixed across child outcome assessed and method/source of assessment. Some studies find no significant effect of Pyramid Model implementation on teacher-reported social skills or observed developmental skills, such as cognitive, language, social, and motor skills (Hemmeter et al., 2022; Hemmeter et al., 2021). Other studies find no significant effects on classroom prosocial or challenging behavior when using direct observations (Hemmeter et al., 2016). A more recent study found a positive effect on positive social interactions using the same direct observation protocol for the subgroup of children in intervention classrooms with an elevated risk for behavior problems, though no difference in challenging behavior was observed compared to children in control group classrooms (Hemmeter et al., 2021). In this same study, no significant differences were found between the intervention versus comparison group of children on standardized direct assessments of children's cognitive, language, and motor skills.

Other studies of Pyramid Model in early childhood programs have found some positive effects on child outcomes, when targeted teacher professional development support and follow-up is provided. In these studies, teachers receive intentional professional development consisting of workshops, implementation guides, classroom materials, as well as focused practice-based coaching. For example, when teachers receive intensive practice-based coaching support for implementing Pyramid Model practices, children in intervention classrooms are rated higher by teachers on social skills than children in control classrooms (Hemmeter et al., 2021; Hemmeter et al., 2016). This finding held true for both children with elevated behavior problems, as well as children

without behavior problems. Hemmeter et al. (2021) also found that effects on child outcomes were mediated by teacher classroom implementation of Pyramid Model strategies. Greater teacher implementation of classroom strategies led to increases in teacher-reported social skills for all children and decreased problem behavior for children without identified behavior problems (Hemmeter et al., 2021).

Another program, Jump Start, provided a short-term intervention to children, along with teacher mental health consultation utilizing a variety of evidence-based practices, including the Pyramid Model (Natale et al., 2020). Parent and teacher reports were used to rate children's initiative, self-control, attachment, and behavior concerns, all of which showed significant pre- to post-test improvements for children participating in the program. Moreover, a follow-up survey completed by families 1-year post-intervention revealed that rates of children receiving special education, therapeutic, or intervention services were lower than national averages. Of families who completed the follow-up survey, only 0.9% indicated their child was at risk for expulsion, compared to 11.6% of families at the beginning of the program. This is consistent with the dramatic decrease in the rates of expulsion from childcare that were reported in the state of Colorado, following their launch of statewide initiatives based around the Pyramid Model (Vinh et al., 2016). The finding is also congruent with findings from a recent study conducted in public school preschool programs, where implementation of the Pyramid Model was associated with decreased risk of child suspension and expulsion (Fox et al., 2021). Continued work is needed to further our understanding of how implementation of Pyramid Model practices, and under which contexts and types of training supports, are related to children's outcomes and development of school-readiness skills.

2.5 Demographic variables associated with teacher and child social-emotional outcomes

There are several teacher variables such as teacher race, ethnicity, age, education level, and years of experience that have been found to be associated with teacher outcomes related to implementation of the Pyramid Model. Hemmeter et al. (2021) examined the relationship between teachers' years of experience and whether they held a degree or a certificate and their rate of reported challenging behaviors in the classroom. Teachers with more experience and who held a degree or certificate reported lower levels of children's challenging behaviors at post data collection (Hemmeter et al., 2021). Hemmeter and team also examined the role of teachers' education level (e.g., held a bachelor's or higher degree) in conjunction with their reported race. Findings indicated that teachers who reported identifying as Black and held a degree were observed to implement higher Pyramid Model strategies and use higher quality teacher-child interactions compared to teachers of other races and of lower educational attainment (Hemmeter et al., 2022).

Several early childhood studies have examined associations between child demographic variables and child social-emotional and behavioral outcomes. For example, child age, sex, and ethnicity have been shown to be related to children's learning behaviors, self-regulation, and their emotional and behavioral adjustment (Bailey and Bulotsky-Shearer, 2022; Bulotsky-Shearer et al., 2023). Other demographic covariates commonly included in studies investigating similar child outcomes include language, maternal education, SES, and household income or family income-to-needs ratio (Goble et al., 2019; Reilly and Downer, 2019; Yang and Purtell, 2023). While there is much more work to be done to extend this research, the above sets of both teacher and child demographic variables have been found to be associated with teacher and child outcomes related to implementation of the Pyramid Model. As such, we include several of them in our analytic models as detailed, below.

3 Materials and methods

3.1 Participants

3.1.1 Teaching staff

All teachers were preschool teachers in the district where the study took place. Of 30 lead preschool teachers (e.g., teacher of record in their classroom) that participated, 16 were enrolled in the intervention and 14 were in the waitlist control group. Lead teachers were 97% female, 56% Black/African American, 33% White, and 10% of another race. Twenty-seven percent of teachers identified as Hispanic and 70% of teachers were born in the United States. Additionally, approximately 7% had an associate's degree and 93% had a bachelor's degree or higher. On average, teachers reported working as a preschool teacher for 10 years (SD = 6.87, range = 1–24 years).

Across the 2 years of the study, there were 23 teacher assistants enrolled. Fifteen teacher assistants were enrolled in the intervention and 8 were in the waitlist control group. Teacher assistants were 96% female, 79% Black/African American, 16% White, and 5% of another race. Seventeen percent of teacher assistants identified as Hispanic and 78% were born in the United States. Thirteen percent reported having a High School diploma or GED, 61% had an associate's degree, and 26% had a bachelor's degree or higher. On average teacher assistants reported working as a preschool teacher for 10 years (SD = 9.83, range = 1–35).

3.1.2 Children

Participants included 519 preschool children across 26 classrooms enrolled in a large, urban school district Head Start program in the Southeastern United States. Head Start is a federally funded program in the United States that provides comprehensive health, education, and nutrition services to children ages three to five from low-income families. Preschool-aged children who participate in Head Start are ages 3–5 years. Participating classrooms were part of a larger study conducted in collaboration with the Head Start program during the 2017–2019 school years. Two hundred eighty-nine children were enrolled in the study's intervention classrooms and 230 children were in the waitlist control group classrooms. Children ranged in age from 36 to 59 months (M = 48.02, SD = 6.74), and 52% were girls. Children (as reported by their primary caregiver) were predominantly Black/African American (90%; 9% White, and 1% of another race).

With respect to ethnicity, 10% were Hispanic. The majority (95%) of children's primary home language was English, and about 10% of children had an Individualized Education Program (IEP) as reported by the school district.

3.2 Procedures

3.2.1 Recruitment and data collection

Approval to conduct this research project was obtained from the university's Institutional Review Board, from the Director of the Head Start programs, the School District, and from the Head Start program's Parent Policy Council. Participants were recruited from ten elementary schools located in a high-poverty and low-academically performing region of the district participating in the "We Rise" district initiative (blinded for review). A randomized, waitlist control research design was implemented at the school level, for two reasons: a) to increase cohesion and collaboration between teachers within schools participating in the intervention, and b) to minimize any potential spillover effects of teachers sharing resources across classrooms within schools that might occur by randomizing classrooms within schools to intervention and control condition (Shadish et al., 2002).

In the fall of the first year of the study (2017–18), all school principals were provided an overview of the project. After consent was obtained from principals, and teachers and teacher assistants, schools were randomized. Half of the participating schools were randomly assigned to either an intervention, or waitlist control condition. One school declined to participate, leaving a total of 9 schools. Parental consent was obtained for all participating children with the assistance of the teaching staff. After one full year of implementation, intervention teachers and the district early childhood program staff requested an extension of implementation of intervention for one additional year, to provide additional support to the teachers.

Over the course of the 2 years, there was minimal attrition. In Year 1, a total of 45 teachers participated (25 lead teachers and 20 assistant teachers). In Year 2, while we retained all of the participating classrooms, there was some movement in teacher participation due to changes in school placement, leaving the district or being promoted to a different position. In total, 5 lead teachers and 3 teachers from Year 1 left the study and 8 new teachers replaced them in the second year.

Participating teachers in intervention schools were offered practice-based coaching and monthly teacher CoP meetings that centered around training and support on effective implementation of the Pyramid Model practices. The intervention group received intervention for 2 years (2017–18 and 2018–19). In the third and fourth years of the study, teachers initially assigned to the waitlist control condition schools were then assigned to the intervention group and participating teachers in the initial intervention group received sustainability support. In the present study we focus on the first 2 years to examine the initial effects of implementing the intervention (i.e., practice-based coaching and monthly CoP meetings).

All teacher and child measures were collected in mid-October and mid-May of each year of the study. For teacher outcomes, observations of teacher classroom implementation of Pyramid Model practices were conducted by the trained research team using the *Teaching Pyramid Model Observation Tool* (TPOT) (Fox et al., 2008). Teachers completed a brief demographic questionnaire in the fall and a self-report of their feelings of self-efficacy in managing challenging behavior *Teachers' Self Efficacy Scale* (TSES) (Tschannen-Moran and Hoy, 2001).

For child outcomes, teachers were asked to complete two scales, rating children's classroom emotional and behavioral adjustment using the *Adjustment Scales for Preschool Intervention* (ASPI) (Bulotsky-Shearer et al., 2008; Lutz et al., 2002) and approaches to learning, using the *Preschool Learning Behavior Scale* (PLBS) (McDermott et al., 2002). Direct assessments of children's self-regulation, using the *Preschool Self-Regulation Assessment* (PSRA) (Smith-Donald et al., 2007), were conducted by the trained research team of graduate and undergraduate students, and research staff. Children were assessed in a quiet space outside of the classroom in a game-like manner and received a sticker for participating.

3.2.2 Implementation of the Pyramid Model intervention supports

As a foundation, the school district's early childhood department universally provided a 2-day introductory workshop on the Pyramid Model practices, which was led by district Head Start Mental Health Coordinators and Curriculum Support Specialists. The training included didactic presentations, video demonstrations, worksheets, and action planning. Workshops provided content related to all Tiers of the Pyramid Model but focused on the universal (Tier 1) and targeted (Tier 2) social-emotional support strategies.

Following the introductory district professional development 2-day workshop, two types of intervention support were provided for those enrolled in the study in the intervention group: (a) on-site practice-based coaching and (b) monthly teacher CoP meetings. Practice-based coaching sessions on school sites were facilitated by a retired early childhood special education teacher and an early childhood curriculum specialist, both hired as key research and implementation team members. The two coaches met with each classroom teaching team (teacher and teacher assistant) every 2 weeks for practice-based coaching. Initially, the coach used observations of the classroom (TPOT) and an interview with the teaching team to develop an action plan based on observed and reported support needs of the teacher and students. This process is consistent with previous research that has used practice-based coaching for the Pyramid Model (Snyder, 2022; Snyder et al., 2015). An action plan, as part of practice-based coaching, is intended to help teachers select data-based goals which are foundational to the Pyramid Model and of interest to the teacher. The individualized coaching sessions also reinforced the content discussed at the CoP meetings. In addition, motivational interviewing, guided video review of classroom implementation, and reflective supervision were used by coaches to encourage and support teachers as they implemented Pyramid Model practices to support all children, including children with challenging behavior. Action plan goals were related to transition strategies, positive behavior interventions, teaching social problem-solving skills, creating classroom rules or expectations, and teaching social-emotional skills such as emotional vocabulary.

TABLE 1 Data collection timeline for teacher measures.

	Year 1		Year 2	
	Fall 2017	Spring 2018	Fall 2018	Spring 2019
TPOT	X	X	X	X
TSES	X	X	X	X

TPOT, Teaching Pyramid Model Observation Tool; TSES, Teacher Self-Efficacy Scale.

An action plan was considered completed when the coach observed the practice had improved in a subsequent session. In the first year, the average number of coaching sessions was 16.00 (SD = 1.29) and the average number of action plans completed was 3.23 (SD = 1.30). In the second year, the average number of coaching sessions was 9.50 (SD = 4.42) and the average number of action plans completed was 2.33 (SD = 1.16).

Monthly teacher CoPs met at a central school location after school, for 2 h. During each meeting, the two coaches and district staff with expertise in early childhood social-emotional development led and moderated a discussion of Pyramid Model social-emotional practices using protocols developed by the National Center for Pyramid Model Innovations (n.d.). Eight in-person CoP meetings were offered during each year (September through May) and seven to eight activities per year, for the first and second year respectively, were assigned for teachers to complete and post virtually through social media (i.e., Edmodo, WhatsApp), in-between meetings. These "homework" activities required a teacher to try out a practice they learned in the CoP and post evidence of implementation (e.g., picture, video, chat) alongside a brief reflection about how it went. In the first year, average CoP teacher attendance was 4.46 (*SD* 3.08) and the average number of teacher "homework" posts was 3.31 (*SD* 2.77). In the second year, average CoP teacher attendance was 5.70 (*SD* 2.74) and the average number of teacher "homework" posts was 5.30 (*SD* 2.67). CoP topics for the first year included (1) foundational strategies, such as building positive relationships with children, co-workers, and families, (2) using positive communication and reinforcement, (3) teaching feelings vocabulary, (4) creating high quality environments, (5) modifying transitions and routines, and, (6) understanding the function and message of challenging behavior. In the second year, topics included (1) building positive relationships with children, co-workers, and families, (2) using cues and visuals to modify transitions and routines, (3) visual reinforcement board to post praise for children for positive behaviors, (4) growth mindset, (5) positive reinforcement, (6) feelings vocabulary, (7) supporting friendship skills, and (8) teaching self-regulation techniques for teachers and children.

3.3 Measures

3.3.1 Teacher measures

Teacher level measures were collected twice each year (once in fall and once in once in spring) throughout the 2-year intervention that teachers participated in, resulting in four total timepoints for teacher measures (see Table 1).

3.3.1.1 Observed social-emotional teaching practices

The Teaching Pyramid Observation Tool for Preschool Children (TPOT) (Fox et al., 2014) was used to assess teachers' implementation of Pyramid Model practices. The TPOT is administered by conducting a 2-h observation and 15- to 20-min interview with the observed teacher. The version of the TPOT used in the present study had 108 indicators organized under 15 key Pyramid Model practice items. Examples of key practices aligned with the Pyramid Model include (a) building positive relationships, (b) creating supportive environments, (c) social emotional teaching strategies, and (d) individualized intensive intervention. Indicators are scored either yes (practice was observed or reported to be implemented during the interview) or no (practice was not observed or not reported to be implemented during the interview). In addition to key practice items, 16 red flags were included on this version of the TPOT. Red flags are practices that are either inconsistent or incompatible with Pyramid Model practices. The range of scores for key practice items was 0 to 108, and for red flags was 0 to 16. Examples of red flags include "transitions are more often chaotic than not" and "emotions are never discussed in the classroom".

A TPOT certified trainer conducted a 2-day intensive observation training required for all observers on the research team. Research team members became certified reliable observers when they achieved at least 80% inter-observer agreement from the master coder. In the fall and spring, reliable observers conducted 2.5–3-h observations in the classrooms during a typical classroom morning routine and each of the TPOT indicators were rated. For the present study, 20% of classrooms were double coded throughout the course of the fall and spring data collection time points, to check reliability and to minimize observer drift from master codes.

3.3.1.2 Teacher-reported feelings of self-efficacy

Teachers reported on their feelings of self-efficacy for managing children's behaviors using the eight items that make up the *Efficacy for Classroom Management* subscale of the Teachers' Self Efficacy Scale (TSES) (Tschannen-Moran and Hoy, 2001). Teachers rated the degree to which they felt effective in applying classroom rules and managing disruptive behavior on a 9-point Likert-type scale (1 = Nothing, 3 = Very little, 5 = Some influence, 7 = Quite a bit, and 9 = A great deal). Sample items include, "To what extent can you make your expectation clear about student behavior?" and, "How well can you keep a few problem students from ruining an entire lesson?" Items assess the teacher's judgment of their capability to deal with disruptive student behaviors and bring about desired behaviors (sample item: "How much can you do to control disruptive behavior in the classroom?"). The *Efficacy for Classroom Management* subscale has demonstrated strong reliability (Cronbach's $\alpha = 0.90$). Cronbach's alpha for this sample was 0.90.

3.3.2 Child measures

Child level measures were collected twice (once in fall and once in once in spring) for both cohorts of students in participating classrooms over the course of the 2-year intervention. Child data from cohort 1 (Year 1 of the intervention) and cohort 2 (Year 2 of the intervention) were combined, resulting in two total timepoints

TABLE 2 Date collection timeline for child measures.

	Fall (Years 1–2)	Spring (Years 1–2)
Cohort 1		
ASPI	X	X
PSRA	X	X
PLBS	X	X
Cohort 2		
ASPI	X	X
PSRA	X	X
PLBS	X	X

ASPI, Adjustment Scales for Children and Adolescents; PSRA, Preschool Self-regulation Scale; PLBS, Preschool Learning Behaviors Scale.

of data for child measures, pre- and post-intervention year (see Table 2).

3.3.2.1 Classroom emotional and behavioral adjustment

Teachers completed the *Adjustment Scales for Preschool Intervention* (ASPI) (Bulotsky-Shearer et al., 2008; Lutz et al., 2002) in the fall and spring to assess children's challenging behaviors. The ASPI is a 144-item teacher-report measure of teacher observations of children's adaptive and maladaptive behavior across 22 routine preschool classroom situations, such as peer relationships, interactions with the teacher, relationships with peers, involvement in structured and unstructured classroom activities, and games and play. The ASPI has five valid and reliable scales: aggressive, oppositional, inattentive/hyperactive, withdrawn/low energy, and socially reticent behavior (Cronbach's αs = 0.75–0.84). Additionally, two higher-order dimensions of the ASPI were validated: Underactive Behavior (comprising the withdrawn/low energy and socially reticent behavior scales) and Overactive Behavior (comprising the aggressive and inattentive/hyperactive behavior scales) problems. Underactive behavior is comprised of the withdrawn/low energy (e.g., "cannot work up the energy to face anything new, sits so quietly you don't know if he/she is attending or not") and the socially reticent behavior scales (e.g., "is too timid to join in play, waits for teacher to greet him/her first, needs encouragement to join in games"). The Overactive behavior dimension includes aggressive (e.g., "tries to push in front of others in line"), oppositional (e.g., "helps with jobs unless in a bad mood"), and inattentive/hyperactive (e.g., "answers questions before taking time to think") behaviors.

Convergent and divergent validity has been established with constructs of interactive peer play, behavior problems, temperament, emotion regulation, direct observations of classroom behavior problems, language skills, and learning behaviors (Bulotsky-Shearer and Fantuzzo, 2004; Bulotsky-Shearer et al., 2008; Lutz et al., 2002). In the present study, children's raw scores were converted to standardized *T* scores based on the factor structure derived from a large-scale Head Start study (Bulotsky-Shearer et al., 2008).

3.3.2.2 Self-regulation

Children's self-regulation was assessed in the fall and spring using the *Preschool Self-Regulation Assessment* (PSRA) (Smith-Donald et al., 2007), which was conducted by trained assessors. The PSRA is a brief battery of tasks that is used to assess preschool-aged children's ability to demonstrate emotional, attentional, and behavioral self-regulation. The PSRA battery includes four structured tasks, including two delay tasks (Toy Wrap and Snack Delay) and two tasks requiring children to filter competing stimuli (Pencil Tap and Balance Beam). Children completed all four tasks in the present study. In the Toy Wrap activity task, children were tasked to resist peeking while the assessor noisily wraps a "surprise." In the Snack Delay task, children were asked to wait for a cue from the assessor before retrieving a desirable snack from under a clear cup. In the Pencil Tap task, children were asked to tap a pencil once when the assessor taps twice and tap the pencil twice when the assessor taps the pencil once. Lastly, in the Balance Beam task, children were asked to walk along a line three times while getting slower each time. The assessor guided the child through each of these tasks and administered practice trials before beginning the assessment. Validity evidence is established for the use of the measure with ethnically diverse Head Start children (Denham et al., 2014). Raw scores based on the validation study were calculated for each of the four tasks administered (Smith-Donald et al., 2007).

3.3.2.3 Approaches to learning

The *Preschool Learning Behavior Scale* (PLBS) (McDermott et al., 2002) is a 29-item teacher-report measure of children's approaches to learning that was used to assess children's learning behaviors in the classroom in the fall and spring of each school year. Lead teachers rated each item on a 3-point Likert-type scale ("Most often applies," "Sometimes applies," or "Doesn't apply"). Sample items include "Says task is too hard without making much effort to attempt it," "Acts without taking sufficient time to look at the problem or work out a solution," and "Is unwilling to accept help even when an activity proves too difficult." The PLBS has been validated for use with low-income, urban Head Start children. The measure assesses three dimensions of learning behaviors: Competence Motivation, Attention Persistence, and Attitude Toward Learning (Cronbach's αs = 0.85, 0.83, and 0.75, respectively). The Competence Motivation scale measures children's willingness to take on tasks and their determination to successfully complete activities. The Attention/Persistence scale dimension assesses children's persistence with difficult tasks and the degree to which children pay attention. Items on the Attitude Toward Learning scale dimension assess skills that promote learning such as children's ability to cope with frustration and desire to please their teachers. Convergent and divergent validity has been established for urban, low-income preschool children with direct assessments of cognitive ability, receptive and expressive vocabulary skills, teacher- and parent-rated interactive peer play competencies, and direct observations of children's classroom self-regulation (Fantuzzo et al., 2004; McDermott et al., 2002). Raw score totals for each of the three dimensions were created based on the published factor structure, and the total scores were converted to standardized *T* scores based on the normative sample used (McDermott et al., 2002).

3.4 Data analysis

3.4.1 Intervention effects on teacher outcomes

To examine the effects of being assigned to the Pyramid Model intervention condition on teacher outcomes over

the course of 2 years of implementation, a series of latent growth curve analyses (LGCA) in Mplus version 8 (Muthén and Muthén, 2017) were conducted. First, data from the fall and spring timepoints from study years 1 and 2 (four timepoints) were used to estimate the intercept (initial status) and slope (rates of growth). Separate models were estimated for each of the teacher outcomes: teachers observed use of evidence-based strategies (TPOT positive practices), red flags (TPOT), and teacher reported feelings of self-efficacy (TSES) controlling for teacher age (years), Ethnicity (1 = Hispanic), Race (1 = Black), years teaching, and education level (1 = bachelor's degree).

For LGCA, the lack of significance ($p > 0.05$) of the chi-square test of model fit was used to assess fit of the overall model (Kline, 2005). The Bentler comparative fit index (CFI) (Bentler, 1990), the root mean square error of approximation (RMSEA; (Steiger and Lind, 1980), and the Standardized Root Mean Square Residual (SRMR) (Hu and Bentler, 1995) were also used to assess closeness of model fit. CFI values greater than.90 (Bentler, 1990), RMSEA values of.06 or less (Steiger, 1990), and SRMR values less than 0.08 (Bentler, 1990) were used as cutoff points for acceptable model fit.

3.4.2 Intervention effects on child outcomes

A series of three-level models were estimated in Mplus version 8 (Muthén and Muthén, 2017) to examine the effects on children's outcomes of their teacher being assigned to the Pyramid Model intervention condition. First, unconditional models were estimated to determine the percentage of variance attributed to child (level 1), classroom (level 2), and school (level 3) in each of the three child outcomes: classroom emotional and behavioral adjustment (ASPI), self-regulation (PSRA), and approaches to learning (PLBS) scores. Then, conditional models were estimated, entering the following variables at level 1 (child): child age (months), sex (1 = female), IEP status (1 = child had a formal IEP and disability diagnosis), year in the intervention (0 = enrolled in the first year of the study, 1 = enrolled in the second year), and fall scores on the respective outcome measure. At level 2 (classroom), the intervention variable was included as a predictor of child outcomes because the intervention assignment was at the classroom level. No variables were entered at level 3 (school).

4 Results

4.1 Teacher outcome models

To examine effects on teacher practices, three latent growth curve models were estimated separately for each teacher outcome: (a) teachers observed use of evidence-based strategies (TPOT positive practices), (b) observed red flags (TPOT), and (c) teachers' self-report of feelings of self-efficacy (TSES). First, unconditional LGCA models were estimated to determine if there was significant variance in initial status (intercept) and rates of growth (slope) in teacher outcomes. For all three outcomes, there was significant variance at the intercept, indicating that there was inter-individual variability in teachers' initial classroom practices and feelings of self-efficacy. All models showed significant variance around the slope, suggesting there was inter-individual variability in the rates of change in these outcomes over the four time points as well. See Table 3 for descriptive statistics for teacher outcomes over time and Table 4 for the results of the LGCA models.

4.1.1 Intervention effects

On average, positive teacher practices observed on the TPOT increased over time, while red flags as observed on the TPOT decreased over time. Teachers' self-report of their self-efficacy increased over time. Next, conditional LGCA models were estimated for each teacher's outcome including intervention assignment as predictors of teachers' initial scores and rates of change over the four timepoints. The three final models did not fit these data very well. Fit statistics for final models are as follows; for TPOT positive practices, $\chi^2(10) = 16.08$, $p = 0.71$; CFI = 1.00; RMSEA = 0.00; SRMR = 0.133, for red flags: $\chi^2(201) = 48.562$, $p < 0.01$; CFI = 0.43; RMSEA = 0.23; SRMR = 0.13, for teacher self-efficacy: $\chi^2(10) = 35.33$, $p < 0.05$; CFI = 0.68; RMSEA = 0.14; SRMR = 0.33.

4.1.1.1 Intervention effects on observed positive teaching practices

See Table 4 for full model results with parameter estimates for TPOT positive practices, red flags, and teacher self-efficacy. The scores for TPOT positive practices are designed to measure implementation of Pyramid Model practices over time. For the TPOT positive teaching practices model, the intervention condition had a significant effect on both the intercept and slope. Teachers in the intervention group started out with a significantly lower score on TPOT positive practices than the teachers in the control group. The intervention effect on the slope suggests that the TPOT score of teachers in the intervention group increased at a faster rate than teachers in the control group.

4.1.1.2 Intervention effects on observed red flags

Overall, the number of red flags (on the TPOT red flag subscale) decreased over time. For the red flag model, the intervention condition had a significant effect on both the intercept and slope. Teachers in the intervention group started out with a significantly higher number of red flags than the teachers in the control group. The intervention effect on the slope suggests that teachers in the intervention group decreased their use of red flags over time at a faster rate than teachers in the control group.

4.1.1.3 Intervention effects on teacher-reported self-efficacy

Overall, the scores on the teacher self-efficacy measure increased over time. For the teacher self-efficacy model, the intervention condition had a significant effect on both the intercept and slope. Teachers in the intervention group started out with a significantly lower score on the self-efficacy measure than the teachers in the control group. The intervention effect on the slope suggests that the self-efficacy of teachers in the intervention

TABLE 3 Descriptive statistics for teacher measures (Fall 2017 – Spring 2019).

	Year 1						Year 2					
	Fall			Spring			Fall			Spring		
	n	*M*	SD	*n*	*M*	SD	*n*	*M*	SD	*n*	*M*	SD
Intervention group												
TPOT												
Percent score	14	57.72	16.64	13	68.89	18.21	13	53.43	22.32	12	57.98	26.02
Red flags	14	3.21	2.58	13	2.69	2.84	13	3.92	3.62	12	1.67	2.71
TSES												
Self-efficacy	26	6.74	1.32	26	7.35	1.13	22	7.46	1.10	20	7.58	1.30
Waitlist control group												
TPOT												
Percent score	11	73.13	9.70	10	57.59	21.88	10	50.27	21.13	10	54.83	17.87
Red flags	11	1.18	0.87	10	2.90	2.88	10	5.00	4.27	10	2.70	2.58
TSES												
Self-efficacy	14	7.57	0.88	14	7.73	1.10	15	7.57	1.31	13	6.93	1.66

Sample includes all Lead Teachers and Teacher Assistants. TPOT, Teaching Pyramid Model Observation Tool; TSES, Teacher Self-Efficacy Scale.

TABLE 4 Teacher growth model results.

	TPOT		Red Flags		Self-Efficacy	
	B	SE	B	SE	B	SE
Intercept						
Age	0.18	0.15	−0.001	0.04	−0.04**	0.02
Hispanic	6.15	6.02	0.14	0.89	1.86**	0.54
Black	2.81	6.80	0.06	1.15	1.34**	0.40
Years teaching	0.98**	0.35	−0.08	0.05	0.01	0.02
Bachelor's degree	7.10	5.73	−2.98*	1.31	0.31	0.39
Intervention	−11.12*	4.84	1.61*	0.76	−0.89**	0.30
Slope						
Age	−0.26***	0.07	0.05**	0.01	0.02**	0.01
Hispanic	−0.77	3.28	−0.64	0.40	−0.76**	0.29
Black	0.02	3.38	−0.94	0.63	−0.56*	0.27
Years teaching	0.10	0.19	−0.05	0.03	−0.02*	0.01
Bachelor's degree	4.99	2.59	0.11	0.62	−0.10	0.12
Intervention	4.34*	2.12	−0.94*	0.40	0.40***	0.11

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. $N = 48$. Parameter estimates presented are unstandardized. TPOT, Teaching Pyramid Model Observation Tool; TSES, Teacher Self-Efficacy Scale.

group increased at a faster rate than the self-efficacy of teachers in the control group.

4.1.2 Teacher demographic covariates associated with teacher outcomes

4.1.2.1 Teacher demographic covariates associated with observed positive teaching practices

Teacher age, ethnicity, race, number of years teaching, and whether the teacher had at least a bachelor's degree were included in all three growth models as covariates. For the TPOT positive practices model, the number of years teaching had a significant effect on the intercept of the model; teachers who had more years of teaching experience scored significantly higher on positive practices at the start of the study than teachers who had been teaching for fewer years. There were no significant effects of the covariates on the slope for the TPOT positive practices model.

4.1.2.2 Teacher demographic covariates associated with observed red flags

For the red flags model, whether the teacher held at least a bachelor's degree had a significant effect on the intercept of the model. Teachers with at least a bachelor's degree demonstrated significantly fewer red flags at the start of the study than teachers who did not. There were no significant effects of the covariates on the slope for the red flags model.

4.1.2.3 Teacher demographic covariates associated with teacher-reported self-efficacy

For the teacher self-efficacy model, teacher age, whether the teacher was Hispanic, and whether the teacher was Black had a significant effect on the intercept of the model. Teachers who were older had significantly lower self-efficacy at the start of the study than teachers who were younger. Teachers who were Hispanic had significantly higher self-efficacy at the start of the study than teachers who were not Hispanic. Teachers who were Black had significantly higher self-efficacy at the start of the study than teachers who were not Black. Teacher age, whether the teacher was Hispanic, whether the teacher was Black, and number of years teaching had a significant effect on the slope of the model. Older teachers had a faster increase in self-efficacy than younger teachers. Teachers who were Hispanic, teachers who were Black, and teachers who had been teaching for more years all had a slower increase in self-efficacy over time than teachers who were not Hispanic, teachers who were not Black, and teachers who had been teaching for fewer years.

4.2 Child outcome models

The results of the unconditional and conditional models testing the effects of the intervention and covariates on child outcomes are reported below. Table 5 includes the descriptive statistics for child-level outcomes. Tables 6–8 include the parameter estimates for the conditional models estimated for classroom emotional and behavioral adjustment, self-regulation, and approaches to learning outcomes.

4.2.1 Classroom emotional and behavioral adjustment

The unconditional model indicated that for aggression 87.8% of the variance was attributable to differences between children, 9.9% of variance was attributable to differences between classrooms, and 2.3% of the variance was attributable to differences between schools. For withdrawn/low energy behavior 76.8% of the variance was attributable to differences between children, with 21% of variance attributable to differences between classrooms, and 2.2% of the variance attributable to differences between schools. For socially reticent behavior 79.8% of the variance was attributable to differences between children, 19.6% of variance was attributable to differences between classrooms, and 0.6% of the variance was attributable to differences between schools. For oppositional behavior 89.8% of the variance was attributable to differences between children, 9.5% of variance was attributable to differences between classrooms, and 0.7% of the variance was attributable to differences between schools. For inattentiveness/hyperactivity 89.6% of the variance was attributable to differences between children, 9.8% of variance was attributable to differences between classrooms, and 0.6% of the variance was attributable to differences between schools.

The conditional model indicated that fall scores positively and significantly predicted spring scores for all five ASPI subscales. Older children had lower scores on withdrawn/low energy and socially reticent subscales in the spring, and girls scored lower on the aggression subscale than boys. Whether the child's teacher participated in the intervention group had no significant effect on any ASPI subscale scores controlling for fall scores, and child demographic covariates ($p > 0.05$).

4.2.2 Preschool self-regulation

The unconditional models indicated that for the balance beam task, 90% of the variance was attributable to differences between children, 4.4% of variance was attributable to differences between classrooms, and 5.6% of the variance was attributable to differences between schools. For the pencil tap task, 83.3% of the variance was attributable to differences between children, 8.7% of variance was attributable to differences between classrooms, and 8% of the variance was attributable to differences between schools. For the toy wrap task, 88.3% of the variance was attributable to differences between children, 6.3% of variance was attributable to differences between classrooms, and 5.4% of the variance was attributable to differences between schools. For the snack delay task, 93.4% of the variance was attributable to differences between children, 5% of variance was attributable to differences between classrooms, and 1.6% of the variance was attributable to differences between schools.

The conditional model indicated that age and fall scores both positively and significantly predicted spring scores for all four tasks. Sex and IEP status significantly predicted spring toy wrap and snack delay task scores; girls scored higher than boys on both tasks and children who had an IEP scored lower on both tasks than children who did not have an IEP. Intervention had no significant effect on any of the four PSRA task scores controlling for fall scores and child demographic covariates ($p > 0.05$).

4.2.3 Approaches to learning

Unconditional models indicated that for competence motivation, 58.6% of the variance was attributable to differences between children, 38.1% of variance was attributable to differences between classrooms, and 3.3% of the variance was attributable to differences between schools. For attention/persistence, 70.5% of the variance was attributable to differences between children, 21.5% of variance was attributable to differences between classrooms, and 8% of the variance was attributable to differences between schools. For attitude toward learning 69% of the variance was attributable to differences between children, 24.3% was attributable to differences between classrooms, and 6.7% was attributable to differences between schools.

The conditional models indicated that fall scores positively and significantly predicted spring scores for all three subscales. Again intervention group had no significant effect on any of the subscale scores ($p > 0.05$).

5 Discussion

The purpose of this study was to examine the effects of early childhood teachers' participation in implementation support for the Pyramid Model for Promoting Social and Emotional Competence in Infants and Young Children. Through a research partnership with an urban district Head Start program, we co-developed, implemented, and evaluated the effects of teacher participation in practice-based coaching and CoPs as facilitators of uptake of Pyramid Model practices through a small, randomized

TABLE 5 Descriptive statistics of child measures (both cohorts combined).

	Fall						Spring					
	Intervention			Waitlist			Intervention			Waitlist		
	n	*M*	SD	*n*	*M*	SD	*n*	*M*	SD	*n*	*M*	SD
ASPI												
Aggressive	260	49.83	7.71	180	49.93	7.69	254	50.44	7.81	180	49.55	7.33
Low energy	260	49.98	7.47	180	48.02	6.08	254	49.51	7.19	180	47.67	5.65
Socially reticent	260	47.53	7.54	180	46.45	7.14	254	48.00	7.54	180	45.04	6.50
Oppositional	260	49.04	7.77	180	50.18	7.83	254	48.98	7.73	180	49.39	7.27
Inattentive	260	51.12	8.86	180	50.95	7.77	254	51.07	8.75	180	50.23	7.72
PSRA												
Balance beam	227	1.16	3.82	184	0.82	3.04	221	2.12	3.83	183	2.17	3.98
Pencil tap	228	23.96	32.77	185	21.76	31.88	221	41.69	39.24	183	38.73	37.86
Gift wrap peek	228	42.79	22.68	184	41.02	24.61	222	48.50	19.80	184	47.81	19.95
Snack delay	227	4.11	1.22	184	4.19	0.97	222	4.20	0.90	184	4.20	0.93
PLBS												
Competence motivation	270	48.73	11.27	180	48.99	9.48	248	49.35	10.05	175	52.49	8.47
Attention/persistence	267	48.33	11.05	184	47.40	9.38	248	49.84	10.21	176	50.98	9.24
Attitude toward learning	268	50.67	10.75	186	50.38	8.79	250	50.14	9.49	175	52.61	9.15

ASPI, Adjustment Scales for Children and Adolescents; PSRA, Preschool Self-regulation Scale; PLBS, Preschool Learning Behaviors Scale.

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TABLE 6 Estimates of level 1 and level 2 predictors of adjustment scales for preschool intervention.

Predictors	Aggressiveness		Withdrawn/Low energy		Socially reticent		Oppositional behavior		Inattentiveness/Hyperactivity	
	B	Posterior SD	B	Posterior SD	B	Posterior SD	B	Posterior SD	B	Posterior SD
Level 1										
Age	0.00	0.05	−0.12*	0.05	−0.16*	0.05	0.03	0.05	−0.09	0.05
Female	−1.48*	0.56	−0.32	0.55	−0.49	0.56	0.011	0.61	−1.11	0.67
IEP	−0.08	1.17	−0.24	1.16	2.45*	1.17	0.24	1.27	−0.76	1.35
Fall scores	0.51*	0.04	0.30*	0.04	0.45*	0.04	0.44*	0.04	0.46*	0.04
Study year	−1.42*	0.56	0.99	0.58	−0.29	0.60	−1.36*	0.65	−1.43*	0.70
Level 2										
Intervention	1.12	1.82	0.56	2.09	1.90	2.12	−0.63	2.21	0.28	2.07

*$p < 0.05$. Parameter estimates are unstandardized. ASPI, Adjustment Scales for Children and Adolescents; PSRA, Preschool Self-regulation Scale; PLBS, Preschool Learning Behaviors Scale.

control trial. By providing these additional implementation supports, our aim was to increase teachers' comfort with the Pyramid Model practices and framework leading to their ability to effectively apply teaching strategies in their classrooms. We found positive effects of teachers' participation in the intervention on observed classroom social-emotional teaching practices and teacher-reported feelings of self-efficacy related to managing children's challenging behaviors, as compared to teachers in the waitlist control group. However, we did not find significant differences between the social-emotional, behavioral, or self-regulation outcomes of children enrolled in the intervention classrooms as compared to waitlist control classrooms. Below, we contextualize the findings in the broader literature and discuss limitations and future directions of this work.

The first research question examined the effects of being assigned to participate in the intervention group on teachers' social-emotional teaching practices in the classroom. We hypothesized that being assigned to the intervention group would increase teachers' use of evidence-based social-emotional teaching strategies, reduce teachers' use of behaviors that are not aligned with the Pyramid Model (observed red flags), and increase teachers self-reported feelings of self-efficacy related to managing challenging behavior in the classroom. In support of our hypotheses, teachers in the intervention group increased their use of evidence-based strategies at a faster rate than the teachers in the control group. Also, teachers in the intervention group decreased their use of red flags, or behaviors counter to the Pyramid Model practices, at a faster rate than the teachers in the control condition. Finally, teachers in the intervention group reported increased feelings of self-efficacy at a faster rate over the course of the intervention years than the teachers in the control group.

Findings comport with a growing body of early childhood research documenting the positive benefit of practice-based coaching related to implementation of the Pyramid Model teaching practices. Efficacy trials conducted by Hemmeter et al. (2021) 2016 and others examining the effects of individualized coaching supports (Snyder et al., 2015) have shown that effective practice-based coaching is associated with teachers' increased fidelity of implementation of Pyramid Model practices. With this type of coaching, teachers have shown improvements in their ability to implement positive social-emotional teaching practices, reduce their reliance on punitive or reactive behavior in the classroom, and report feeling more confident in their ability to effectively manage difficult behavior (Hemmeter et al., 2022, 2016).

Our study extends prior research by documenting the positive effects on teachers' classroom practices from teacher participation in practice-based coaching in conjunction with peer learning through CoP meetings. Given that this study was implemented in a high-poverty neighborhood with under-resourced schools, findings make a unique contribution, especially considering prior literature on the effectiveness of intervention supports used (e.g., practice-based coaching, CoPs). For example, the use of practice-based coaching has been found to improve culturally responsive practice in early childhood classrooms (Kranski and Steed, 2022). Using a CoP model has been found to reduce burnout and compassion fatigue in other fields (e.g., healthcare; Gracia Gozalo et al., 2019) and has been touted as an effective practice to address racial inequities and bring about systemic change (Potapchuk, 2007). Taken together, the intervention supports used in this study may

TABLE 7 Estimates of level 1 and level 2 predictors of preschool self-regulation assessment.

	Balance beam		Pencil tap		Toy wrap		Snack delay	
Predictors	B	Posterior SD	B	Posterior SD	B	Posterior SD	B	Posterior SD
Level 1								
Age	0.17*	0.02	1.85*	0.19	0.73*	0.15	0.03*	0.01
Female	0.06	0.37	−1.32	2.97	9.11*	1.81	0.22*	0.09
IEP	−1.36	0.70	−4.35	5.84	−10.76*	3.48	−0.56*	0.17
Fall scores	0.28*	0.05	0.53*	0.05	0.15*	0.04	0.18*	0.04
Study year	0.00	0.38	0.64	3.11	−2.81	1.83	−0.11	0.09
Level 2								
Intervention	0.05	0.65	4.64	6.38	1.53	3.75	0.02	0.16

*$p < 0.05$. Parameter estimates are unstandardized.

TABLE 8 Estimates of level 1 and level 2 predictors of preschool learning behavior scale.

	Competence motivation		Attention persistence		Attitude toward learning	
Predictors	B	Posterior SD	B	Posterior SD	B	Posterior SD
Level 1						
Age	0.05	0.05	0.07	0.06	−0.01	0.06
Female	0.37	0.70	1.08	0.70	0.73	0.72
IEP	−1.18	1.59	−1.80	1.50	−1.17	1.52
Fall scores	0.41*	0.03	0.48*	0.03	0.40*	0.03
Study year	0.93	0.75	1.31	0.74	1.17	0.75
Level 2						
Intervention	−2.23	2.81	−1.14	2.42	−2.42	2.67

*$p < 0.05$. Parameter estimates are unstandardized.

shed light on ways to address complex issues in similarly under-resourced areas.

Future studies using an implementation science perspective need to unpack how the two training components operated in tandem to enhance teachers' use of strategies in the classrooms and teachers' feelings of effectiveness in addressing challenging behavior. Future research could examine within the intervention group, the timing of relative changes in observed classroom positive social-emotional practices, whether this occurred over the first 2, 3, or 4 timepoints. In addition, it would be important to examine whether the dosage in either or both supports influenced teacher change differently; or whether participating in practice-based coaching cycles had a different or stronger influence on teachers' outcomes, than CoP participation alone. For example, Artman-Meeker et al. (2022) found that when they implemented a tiered coaching model, at three different levels of intensity, individualized coaching support led to changes in teachers' uptake of Pyramid Model practices. In this study, teachers were matched to one of three tiers, based on their profile of observed classroom practices, individual characteristics and preferences. Findings suggested that the fit between the teacher's coaching needs and preferences, and the type of coaching support provided may be as important, if not more important, than the amount of coaching support teachers receive. Prior research also suggests that peer learning can be a powerful mechanism to provide support to teachers, especially early childhood or preschool teachers who often feel isolated from other teachers in K-12 school systems (Artman-Meeker et al., 2022; Cappella et al., 2021). This may have been especially true for teachers participating in the intervention group in this context, as teachers in high-poverty districts are faced with other isolating and draining issues that impact teaching practices and self-efficacy.

In addition, we sought to develop a set of supports and deliver them in collaboration with the district program, so that ultimately the intervention supports could be implemented more broadly and sustained in the longer term by the program itself. The coaches in our project who delivered the practice-based coaching cycles and facilitated the communities of practice, were also employed by the district program, and had previously worked as special education or early childhood teachers within the district program. Our team's collaborating coaches and administrators had insider knowledge and relationships with teachers and schools that we did not have as university researchers.

Incorporating a partnership-based approach, we implemented several steps that we hoped facilitated the success of our project. First, we collaborated closely in the design of the program with the district staff and former teachers, adapting creative ways to coach teachers and engage teachers in CoPs, by combining evidence-based strategies knowing the landscape of practical day-to-day realities of the teachers participating. Using social media (WhatsApp for example) to keep teachers connected throughout the year and accountable to showcasing their classroom work with others, was one such creative way our team chose to

address teachers' feelings of isolation and lack of engagement or keeping up with the Pyramid Model didactic content. Second, implementation support was offered and delivered to teachers on-the-ground at school sites by district staff and former teachers. We hoped delivery by familiar, trusted individuals would encourage teachers to participate and increase the potential for longer-term adoption and sustainability by the larger program once the project ended. From an implementation science perspective, interventions within education programs that consider the internal capacity of systems and build upon their existing strengths have the greatest potential for feasible uptake and acceptability (Morris et al., 2022; Snyder et al., 2015). In addition, research on practice-based coaching suggests that internal coaching by an individual within their program leads to higher acceptability by teachers and greater improvements in children's social skills compared to external coaching (Giordano et al., 2021). Future studies might explore how district leaders implement tiered supports for social-emotional learning, particularly in partnership with researchers, to determine the most feasible and cost-effective teacher professional development supports. Identifying the key components that work within systems could be particularly important in high-poverty districts where leaders would likely need to leverage substantial resources to adopt new initiatives that provide social and emotional prevention and intervention practices to benefit students.

The second research question examined the effects on children's outcomes of their teacher being assigned to the Pyramid Model intervention condition. We examined three child outcomes: classroom emotional and behavioral adjustment, self-regulation, and approaches to learning. We predicted that, given prior research suggesting the positive effects of teachers implementing Pyramid model practices on children's challenging behavior (Hemmeter et al., 2022, 2021), having a teacher assigned to the intervention group would decrease children's aggressive, withdrawn, socially reticent, oppositional, and inattentive behavior compared to children in control classrooms. Contrary to hypotheses, we did not find that children showed decreased behavior problems at the end of the year, compared to children in the control classrooms. Similarly, we hypothesized that having a teacher assigned to the intervention group would improve children's self-regulation and approaches to learning skills compared to children in the control classrooms. However, we did not find any differences between gains in in end of the year scores on the balance beam, pencil tap, toy wrap, or snack delay tasks, or on any of the approaches to learning subscales, when comparing children in the control classrooms to children in the intervention classrooms.

Few studies have looked at the connection between teachers' implementation of classroom practices and changes in children's social-emotional skills and behavior problems (e.g., Hemmeter et al., 2022, 2021, 2016; Natale et al., 2020; Vinh et al., 2016). While findings from previous studies are mixed, a growing number of studies find that when Pyramid Model practices are implemented with a high level of fidelity, changes in child social-emotional outcomes are observed (Hemmeter et al., 2021, 2016).

In this study, one reason why we did not find a relationship between teachers' participation in the intervention and changes in child outcomes, compared to control classrooms, might be that on average as a group, teachers did not reach a high enough level of fidelity of classroom implementation that would lead to changes in children's skills and behaviors. Previous research has suggested that high implementation fidelity leads to more robust changes in child outcomes (Hemmeter et al., 2022). In our sample of teachers, on average teachers were observed implementing 50–60% of the practices on the TPOT across the years of the intervention. Future research should examine whether a threshold of practice usage is needed to observe changes in child outcomes and whether within the group of intervention classrooms, variability in implementation of practices, or types of practices, differentially influenced certain child outcomes.

Future studies also can examine, within the intervention group, the extent to which the intensity or dosage of implementation of Pyramid Model practices, or type of practices (Tier 1, 2, or 3) mediates changes in children's outcomes or whether as some studies suggest, changes in child behavior lag behind teachers' participation in the intervention(Strain, 2018). Relatedly, it could be that in our study teacher action plans most often focused on universal practices (Tier 1) and these were not sufficient to address the challenging behavior of some children in the classroom, who required more intensive support.

Finally, there were likely other contextual influences on children's social-emotional and behavioral outcomes that we did not measure in our study, that should be considered in future research. Children in our study were living in a highly concentrated area of urban poverty, and neighborhood poverty has been shown to attenuate gains in preschool children's math and literacy skills and is negatively associated with children's social-emotional skills (e.g., McCoy et al., 2015). Future studies should include contextual factors in the family and community characteristics that might help explain changes in children's skills. In particular, it would be important to include parent surveys that obtained information about the child's home environment, family stability and resource support, as well as information about a child's developmental history. These child and family factors are known to predict children's social-emotional and behavioral skills and while beyond the scope of the current study, would be important to include in future work (Cowan et al., 1994; Duncan et al., 2023; Stormont, 2001).

To this end, on a broader program-wide level, aligned with the Pyramid Model framework, it is critical to consider how early childhood systems, including school administrators and teaching teams can use a lens that considers the whole child within the context of their family, community, and culture. Understanding the child in context, examining the reason behind challenging behaviors, can set the stage for adults to shift their mindsets and change the ways that they respond to children with challenging behaviors. Rather than resorting to exclusionary or punitive practices, taking the time to be intentional to implement a prevention and promotive approach, like the Pyramid Model, can lead to broader systems level changes that may have broader impacts in the long term of teachers' practices, and children's well-being.

5.1 Limitations and future directions

There were several limitations of the study that should be acknowledged. First, an important contribution of the project was our effort to deliver the intervention in targeted schools in an

area identified by the district program as those where teachers and children were most in need of support. However, targeting these schools meant that participating teachers were working in more stressful and less-resourced environments. Participating teachers and children likely faced more daily stressors than teachers and children from more affluent, well-resourced schools and communities. Elevated teacher stress and distrust of any additional demands on their workload placed challenges on our team to cultivate teacher buy-in, trust, and engagement – which we hoped was diffused through the direct collaboration and involvement of district staff. In addition, our original intention was to implement the intervention for 1 year, with the waitlist control schools invited to participate in Year 2. However, intervention teachers in the first year told us that they felt 1 year was not enough, so we extended our intensive intervention support to Year 1 teachers for a second year. We learned the importance in our work for research teams to be able to pivot to meet the real-world needs and challenges of the early childhood systems and providers.

Finally, another limitation is that our initial school randomization procedure did not result in equivalence across schools in teacher practices. In the first year of the study, teachers in intervention schools displayed significantly lower positive practices and higher red flags than teachers in the waitlist control schools. While we controlled for initial teacher practices and other teacher covariates in our latent growth analyses and found that intervention teachers made greater gains that were sustained over the 2 years of the study; we must recognize that there were initial differences at the outset of the study that might have contributed to the change we observed because of the intervention.

5.2 Application to early childhood education policy and practice

Young children entering classrooms who display challenging behavior, such as disruptive or socially withdrawn behavior, are at risk for difficulty developing positive peer and teacher relationships and engaging in learning experiences that form the foundation of their future school success. In addition, early childhood teachers, while natural contributors to children's development and central to children's lives, can be challenged by behavior that disrupts everyday routines in the classroom, placing children at risk for exclusion (e.g., suspension and expulsion) or adding to burnout and fatigue in the early childhood workforce. It is incumbent upon early childhood programs, particularly those who serve children living in low-income communities, to provide resources to teachers and families and to promote positive social-emotional and behavioral skills so that children are set on a positive path forward.

More resources are needed from local, state, and federal funding to increase resources, including personnel (e.g., coaches), to educate teachers about the importance of the whole child recognizing that kindergarten readiness is more than just academics. In addition, intentional system-wide alignment is needed so that teachers and administrators working within early childhood programs are not overburdened by mandates that are duplicative or counter-aligned.

6 Conclusion

In conclusion, our study addressed the need to offer additional professional development interventions to support preschool teachers working in a set of schools located in an area of the district serving a high concentration of families living in poverty. The goal was for the university team to collaborate with the district Head Start program's team, to implement practice-based coaching and teacher communities of practice, focused on the Pyramid Model for Promoting Social and Emotional Competence in Infants and Young Children. We hope through our partnership to create a supportive mentor learning and peer environment for teachers. We hoped that through teachers' participation, teachers would implement more effective classroom social-emotional strategies, resulting in improved feelings of self-efficacy in dealing with classroom challenging behavior. In addition, we hoped that by implementing more classroom strategies, teachers would reduce challenging behavior, ultimately to promote inclusion of all children in the classroom – those with and without behavioral needs. Findings show promise in that we saw positive changes in teacher classroom practices and their feelings of self-efficacy in implementing classroom practices effectively. However, future research is needed to unpack the complex factors that may be associated with changes in children's social-emotional and behavioral outcomes.

Data availability statement

The datasets presented in this article are not readily available because of the researcher team's data agreement with the Head Start program. Requests to access the datasets should be directed to RB-S, rshearer@miami.edu to submit a formal request.

Ethics statement

The studies involving humans were approved by University of Miami IRB & Office Human Subjects Research. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

RB-S: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Supervision, Writing – original draft, Writing – review and editing, Investigation. JE-M: Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review and editing, Investigation, Writing – original draft. ChM: Conceptualization, Investigation, Supervision, Writing – review and editing. CM: Data curation, Formal analysis, Methodology, Writing – review and editing. BL: Formal analysis, Methodology, Writing – review and editing. EH: Writing – review and editing. JB: Data curation, Formal analysis, Investigation, Methodology, Writing – review and editing. RG: Data curation, Investigation, Writing – review and

editing. AG: Data curation, Investigation, Project administration, Writing – review and editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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