Article

Effects of Professional Development on Preschool Teachers' Use of Embedded Instruction Practices

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Abstract

We conducted a randomized controlled potential efficacy trial to examine effects of two variants of the Tools for Teachers (TfT) professional development (PD) intervention on preschool teachers' implementation of embedded instruction practices and children's developmental and learning outcomes. Thirty-six preschool teachers recruited from three school districts were randomly assigned within each district to one of three PD conditions. Preschool children with disabilities (N = 106) from enrolled teachers' classrooms participated in the study. Results showed that, compared with business-as-usual PD teachers, teachers who received either PD intervention wrote higher-quality learning targets for study children. Teachers who received the PD intervention that included on-site coaching implemented more embedded instruction learning trials compared to teachers in the other two conditions. Compared with children whose teachers participated in BAU PD, children whose teachers received either PD intervention had greater developmental and learning gains as measured by standardized assessments.

Implementation science involves the study of methods to promote the systematic uptake of evidence-based practices (EBPs) in routine practice contexts (Eccles & Mittman, 2006). Active implementation science frameworks have been identified as holding promise for bridging the research-to-practice gap in special education and early childhood (EC) special education (Cook & Odom, 2013; Odom, 2009). Although progress has been made in identifying EBPs, the research-to-practice gap is unlikely to be reduced without attention to understanding and creating the conditions that support practice implementation. Odom (2009) identified implementation as the link between EBPs and positive outcomes for children. In EC special education, the Council for Exceptional Children's Division for Early Childhood (2014) identified a set of EBPs for implementation, known as the DEC recommended practices. The recommended practices are informed by the best available empirical evidence, knowledge gained through experience, and the values of the field (Snyder & Ayankoya, 2015). Within active implementation science frameworks, the important role of "enlightened" professional development (PD) to support practitioners' implementation of recommended practices has been recognized (Odom, 2009; Snyder, Hemmeter, & McLaughlin, 2011).

PD has received significant attention as demands for competent EC practitioners have increased and the body of knowledge has

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grown about associations between fidelity of practice implementation and desired child and family outcomes (Diamond, Justice, Siegler, & Snyder, 2013; Winton, Snyder, & Goffin, 2016). Staff selection and PD, including training and coaching, have been identified as key "drivers" of competency in active implementation science frameworks developed for use in EC (Halle, Metz, & Martinez-Beck, 2013). The need to advance the scientific basis for EC PD has been recognized in EC and in EC special education (Diamond et al, 2013; Snyder et al., 2011) with calls to integrate PD systems and approaches across these two areas (Winton et al., 2016).

Despite recognition of the importance of PD for supporting practice implementation, until recently little rigorous empirical evidence has been available about which forms, intensities, and duration of PD are consistently associated with EC practitioners acquiring background knowledge and implementing practices that lead to improved child outcomes (Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011; Piasta et al., 2017). For example, individualized coaching is a PD approach that has been identified as a promising practice for advancing practitioners' content knowledge, for providing ongoing opportunities to try out new approaches to instruction or classroom management, and for receiving feedback on practice implementation (Ochsendorf & Taylor, 2016). Despite the promise of coaching, a need exists to explore the effects of planned variations of coaching (e.g., expert coaching, self-coaching, group coaching), different coaching delivery methods (e.g., face-to-face, virtual), and different doses of coaching. Such evidence could help inform the design and delivery of PD, including coaching.

Moreover, to explicate relationships among coaching, practice implementation, and child outcomes, a need exists to document the fidelity with which coaching is delivered, including detailed information about dose, dose formats, and the coaching components and coaching practices implemented. To date, coaching implementation fidelity data have not been routinely gathered and reported in studies of PD interventions. For example, a systematic review by Stormont, Reinke, Newcomer, Marchase, and Lewis (2015) revealed that only 31% of 29 studies focused on coaching teachers to use social behavior interventions to improve children's social and behavioral outcomes documented using a coaching fidelity measure. Artman-Meeker, Fettig, Barton, Penny, and Zeng (2015) found that only 7% of 41 articles on coaching for EC practitioners provided implementation fidelity data.

For the past 20 years, the field of EC special education has been focused on identifying practices that are supported by evidence and addressing second-generation research questions. Second-generation research questions center on explicating which interventions are most efficacious for which children and families and under what conditions (e.g., Guralnick, 1997). As implementation science has been applied in EC and EC special education, third-generation research questions have been proposed. These third-generation questions revolve around identifying which PD interventions are most efficacious for which EC practitioners, for which EBPs, and under what conditions. To advance the scientific basis for enlightened EC PD, it is important to (a) better define PD, (b) identify structural and substantive features of PD interventions that are most promising for supporting improvements in practice implementation and child outcomes, and (c) conduct rigorous studies to support or refute specified theories of change and analyze whether PD-related improvements in practice implementation mediate child outcomes (Hill, Beisiegel, & Jacob, 2013; Snyder et al., 2012). The focus of the present study was on supporting advances in third-generation research involving EC PD interventions by evaluating the effects of two variants of a PD intervention that involved coaching on preschool teachers' implementation of a recommended and EBP known as embedded instruction (EI).

EI is an evidence-based multicomponent approach for planning, implementing, and evaluating instruction for preschool children with disabilities (Snyder, Hemmeter, McLean, Sandall, & McLaughlin, 2013; Snyder, Rakap, et al., 2015). It involves providing intentional

and systematic instruction on children's individualized learning targets, often aligned with goals and objectives specified on individualized education programs (IEPs), during typically occurring activities, routines, and transitions. This approach to instruction is distinguished by an emphasis on providing learning opportunities that are naturally or logically embedded in activities, rather than decontextualized. For example, turn-taking skills are taught when food is passed out during snack time or musical instruments during circle time, as opposed to conducting isolated direct instruction out of context and using materials that are neither authentic nor naturally occurring. EI was chosen as the focus for the PD interventions in the present study because it is a widely used and recommended practice in early intervention and EC special education with theoretical, practical, and empirical support (Division for Early Childhood, 2014).

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As operationalized in the present study, EI involves 14 key teaching practices organized under four categories: (a) what to teach, which involves writing priority learning targets to guide EI implementation with observable, measurable, and generative skills or behaviors specified in the learning target; (b) when to teach, which involves identifying logical and developmentally appropriate activities, materials, and people to support EI implementation; (c) how to teach, which involves using intentional and systematic instructional procedures to provide EI learning trials on priority learning target skills and ensuring sufficient opportunities to respond and learn; and (d) how to evaluate, which involves using data-based decision making to evaluate whether EI was implemented as planned and results in child learning (Snyder et al., 2013). EI is an individualized approach to instruction that establishes contingent interactions among the child, adult, and environment as well as a mechanism by which children acquire understanding of relationships among skills that they have learned, expectations of the learning environment, and when use of skills is desirable and appropriate (McBride & Schwartz, 2003).

Evidence from 15 published studies showed that EI is an effective approach for teaching young children with varying disabilities targeted developmental, functional, and school readiness skills, including communication, preacademic, adaptive, literacy, and social skills (Snyder, Rakap, et al., 2015). When implemented with fidelity, EI supports children with disabilities to learn skills and demonstrate behaviors that support their access to and participation in the general preschool curriculum, which is a defining feature of inclusion (Division for Early Childhood & National Association for the Education of Young Children, 2009).

Despite empirical evidence supporting EI, the studies reviewed by Snyder, Rakap, et al. (2015) and commentaries by others (e.g., Smith, Warren, Yoder, & Feurer, 2004) has suggested that EI-related practices are not often implemented with fidelity by practitioners without explicit training and individualized supports. Therefore, in the present study, we evaluated the effects of two variants of a PD intervention and business-as-usual (BAU) PD on preschool teachers' fidelity of implementation of EI practices and subsequent outcomes for children. To begin to address third-generation EC PD research questions, we also explored if the two PD variants had differential effects on teachers' fidelity of implementation of EI practices. In addition, we gathered information from teachers about the social validity of the PD interventions and EI practices. Five research questions were addressed:

Research Question 1: Are there differences in the quality of teachers' written priority learning targets to support their implementation of EI with children based on whether they participated in one of the two PD interventions or received BAU PD provided by their school district?

Research Question 2: Are there differences in the occurrence and accuracy with which teachers implement EI learning trials with children with disabilities enrolled in their classrooms based on whether they participated in one of the two PD interventions or received BAU PD provided by their school district?

Research Question 3: Are there differences in how often children demonstrate the skills specified in their priority learning targets based on whether their teachers participated in one of the two PD interventions or received BAU PD?

Research Question 4: Are there differences in children's scores on standardized child developmental and learning assessments based on whether their teachers participated in one of the two PD interventions or received BAU PD?

Research Question 5: What are teachers' perspectives about their PD intervention and EI?

Method

Study Design

We conducted a three-group randomized controlled potential efficacy trial over a school year with 36 preschool teachers recruited from three school districts in three states (n = 13 from District 1 in State 1; n = 12 from District 2 in State 2; and n = 11 from District 3 in State 3). Institutional review board approval for the study was obtained at all performance sites. The unit of random assignment to experimental condition within each school district was at the teacher level. After informed consent was obtained, teachers were assigned to one of three PD conditions at each site through a simple random assignment procedure: Tools for Teachers (TfT) workshops, accompanying implementation guides and materials, and on-site coaching; TfT workshops, accompanying implementation guides and materials, and self-coaching via a website; and BAU PD provided by the school district (see Figure 1). Subsequent to teachers' enrollment but before their random assignment to conditions, two or three children with disabilities from each teacher's classroom were recruited for participation. We recruited children by asking teachers to send home consent forms for all eligible children (i.e., children with IEPs). From the consent forms returned, we randomly selected three children if more than three consent forms were returned. A total of 106 children were enrolled. We referred to these children as "target children" who had "priority learning targets for instruction" for the purposes of the study. We told teachers in all conditions as part of the informed consent process that we would be focusing on the instruction provided to target children during the study.

Participants and Settings

As shown in Table 1, almost all the teachers were women who identified their race as White. More than 60% of the teachers reported bachelor degrees as their highest level of education, and all teachers reported that they were certified. Twenty-six teachers (74.3%) reported that they had taken coursework on young children with disabilities. Teachers reported that they had spent an average of 75.4 months (SD = 57.8) working with preschool children with disabilities. There were no statistically significant differences across the experimental conditions for any of the measured teacher variables. There were no statistically significant or noteworthy differences across experimental conditions in the structure of the preschool day (i.e., full day, half-day), the duration of the preschool classroom day (in minutes), or the number of children enrolled in a classroom. With respect to classroom quality, observers naïve to experimental assignment collected preintervention data using the Classroom Assessment Scoring System (Pianta, LaParo, & Hamre, 2008). We found no statistically significant or noteworthy baseline differences across the three conditions for mean ratings associated with the three Classroom Assessment Scoring System domains (i.e., emotional support, classroom organization, instructional support). The means for emotional support were 5.2, 5.2, and 5 for on-site coaching, self-coaching, and

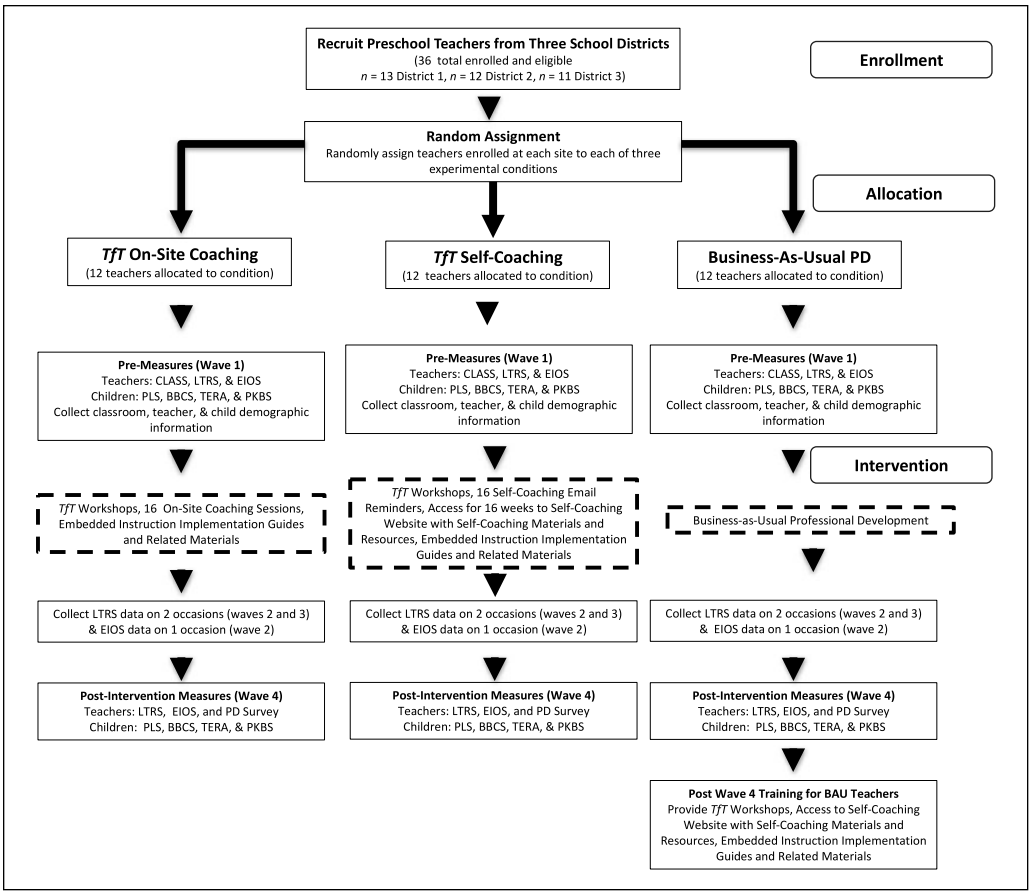

Figure 1. Flowchart of study enrollment, allocation, intervention description by experimental condition, and data collection waves. Information in boxes with dotted lines represents professional development (PD) intervention implemented over the course of the study. TfT = Tools for Teachers; CLASS = Classroom Assessment Scoring System; LTRS = Learning Targets Rating Scale–Research Version 2.0 (Snyder, McLaughlin, et al., 2009); EIOS = Embedded Instruction Observation System (Snyder, Crowe, et al., 2009); PLS = Preschool Language Scale–4 (Zimmerman, Steiner, & Pond, 2002); BBCS = Bracken Basic Concept Scale–Third Edition: Receptive (Bracken, 2006); TERA = Test of Early Reading Ability–Third Edition (Reid, Hresko, & Hamill, 2001); PKBS = Preschool and Kindergarten Behavior Scales–2 (Merrell, 2002); PD = professional development.

BAU, respectively. Instructional support means were 2.5, 2.9, and 2.3 and classroom organization means were 4.8, 4.8, and 4.7 for on-site coaching, self-coaching, and BAU, respectively. Of the 36 classrooms, 28 were inclusive (i.e., classrooms that enrolled children with and without disabilities).

Consistent with study inclusion criteria, all target children had IEPs and were receiving preschool special education services under Section 619 of the Individuals With Disabilities Education Act. Three target children were enrolled in 34 classrooms and two target children in two classrooms. As shown in Table 2, most target children were boys. Children's mean age was 49.4 months ($SD = 8.7$ months). The most commonly reported categories for child race or ethnicity were Caucasian (38%), African American (33%), or Other (21%). Teachers reported that 39% ($n = 41$) of the target children received free or reduced-price lunch. The most commonly reported disability category was developmental delay (59%; $n = 63$). Mean scores on the ABILITIES Index

Table 1. Comparisons of Teacher and Classroom Variables by Experimental Condition.

Variable	On-site coaching (n = 12)	Self-coaching (n = 12)	BAU control (n = 12)	p	Effect size
Gender, *n*					
Female	12	12	11		
Male	0	0	1	.36	.24[a]
Race or ethnicity, *n*					
White	8	10	9		
Black	1	0	2		
Hispanic	1	1	0		
Other[b]	2	1	1	.71	.23[a]
Highest education, *n*					
Bachelor	6	9	8		
Master	6	3	3		
EdS	0	0	1	.39	.24[a]
Teacher age, years					
Mean	41	37.1	38.1		
SD	7.8	10.3	12.3	.63	.03[c]
Preschool disability coursework, *n*					
Yes	9	8	9		
No	2	4	3	.71	.14[a]
Months working in EC					
Mean	111.3	72.1	90.5		
SD	72.9	49.9	51.6	.28	.07[c]
Months with children with IEPs					
Mean	92.3	57.7	76.2		
SD	71.5	50.8	47.6	.35	.06[c]
Structure of preschool day, %					
Full day	50	58	67		
Morning half-day	33	33	25		
Afternoon half-day	17	8	8	.92	.12[a]
Duration class session, min					
Mean	280.3	284.2	309.3		
SD	109.7	108.7	110.9	.78	.01[c]
No. of children enrolled					
Mean	12.1	11.3	12.9		
SD	9.6	4.9	9.3	.88	.01[c]

Note. BAU = business as usual; EC = early childhood; IEP = individualized education program.
[a]Cramér's *V*. [b]On-site condition: one teacher reported Asian; one teacher did not report race or ethnicity. Self-coaching condition: one teacher reported multiracial. BAU condition: one teacher reported Arabic. [c]Eta squared.

(Bailey & Simeonsson, 1991), completed by children's teachers, showed that children in the study sample had mild to moderate functional ability limitations. There were no statistically significant or noteworthy differences on most child variables across the three experimental conditions except for child age and months in preschool. Children in BAU teachers' classrooms were somewhat older and had spent more time in preschool when the study began.

Experimental Conditions

The PD intervention was designed to support preschool teachers' implementation of EI practices and was referred to as TfT. There were two variants of the TfT PD intervention

Table 2. Comparisons of Child Characteristics by Experimental Condition.

Variable	On-site coaching (n = 35)	Self-coaching (n = 36)	BAU control (n =35)	p	Effect size
Gender, %					
Male	85.7	69.4	77.1		
Female	14.3	30.6	22.9	.26	.16[a]
Race or ethnicity, %					
Caucasian	45.7	36.1	31.4		
African American	25.7	30.6	42.9		
Hispanic	11.4	8.3	5.7		
Other[b]	17.1	25	20	.70	.14[a]
Receives free or reduced-price lunch	37.1	33.3	45.7	.56	.12[a]
Disability category, %					
Developmental delay	51.4	72.2	54.3		
Speech language impaired	5.7	5.6	14.3		
Other health impaired[c]	14.3	11.1	2.9		
Autism spectrum disorder	11.4	8.3	5.7		
Cognitive disability[d]	8.6	2.8	11.4		
Not reported	8.6	0	11.4	.25	.24[a]
ABILITIES Index score					
Mean	1.8	1.7	1.7		
SD	0.5	0.4	0.6	.74	.01[e]
Child age, months					
Mean	48.6	46.8	52.7		
SD	8.7	8.1	8.4	.01	.08[e]
Months attended preschool[f]					
Mean	9.2	7.1	13.9		
SD	6.8	6.6	8.9	.001	.13[e]
Months in classroom[g]					
Mean	5.0	4.8	6.2		
SD	5.7	5.1	7.2	.57	.01[e]

Note. BAU = business as usual.
[a]Cramér's *V*. [b]Other includes Asian or Pacific Islander (n = 5), American Indian or Alaskan Native (n = 3), multiracial (n = 7), and other race not specified (n = 7). [c]Other health impaired includes hearing impairment (n = 1), vision impairment (n = 2), and other health impairment not otherwise specified (n = 7). [d]Cognitive disability includes traumatic brain injury (n = 1), Down syndrome (n = 4), and Fragile X syndrome (n = 3). [e]Eta squared. [f]Data based on n = 33 for on-site coaching, n = 35 for self-coaching, and n = 34 for wait-list control. [g]Data based on n = 35 for on-site coaching, n = 35 for self-coaching, and n = 34 for wait-list control.

in the present study, each with three components: workshops, teacher implementation guides and materials, and either on-site coaching in the teachers' classroom or self-coaching via a project-developed website.

TfT workshops averaged 14.9 hr in length. We delivered them at each site in the fall of the preschool year to teachers in both TfT PD intervention conditions (i.e., eight teachers in each workshop). The workshops provided detailed, concrete, and specific descriptions, demonstrations, and video illustrations of the 14 EI teaching practices and opportunities to try out the practices and receive feedback. The content was organized in four modules: overview of EI, planning, implementing, and evaluating. With respect to dose format, across all workshops, delivery of EI content was interactive. Workshop fidelity data showed that adult learning strategies were used 72% of the time. Watching video exemplars of EI, engaging in individual practice activities, and participating in small group activities occurred 10%, 9%, and 8% of the time, respectively.

Teachers were given printed implementation guides and materials aligned with the four workshop modules, which focused on an overview of EI and the 14 EI practices, planning (what and when to teach EI practices), implementing (when and how to teach EI practices), and evaluating (how to evaluate EI practices). Teachers received a digital video camera for recording their implementation of EI with target children and analyzing their implementation of EI. They also received a CD that contained electronic copies of the implementation guides and additional implementation supports (e.g., templates for making activity matrices, examples of quality priority learning targets, EI implementation checklists).

Teachers received on-site coaching or were supported to engage in self-coaching. On-site coaching involved 16 weekly coaching interactions between a teacher and a project-trained coach. These coaching interactions alternated between face-to-face sessions in teachers' classrooms and sessions conducted remotely via e-mail, phone, or videoconferencing. Self-coaching involved access by password to a project-developed website for 16 weeks (not available to teachers in the on-site coaching condition) and receipt of weekly email messages prompting teachers to self-coach. The coaching framework and implementation protocols for both coaching conditions were based on the practice-based coaching framework (Snyder, Hemmeter, & Fox, 2015). Following workshops, teachers in the on-site coaching condition received 16 weeks of coaching from a project-trained coach at each site, who followed the practice-based coaching protocol. One coach had a doctoral degree; the other two coaches had master degrees. They had 24, 10.7, and 12.4 years of EC experience. All three coaches had experience as a lead teacher in an EC classroom. One coach reported additional experience as a speech-language therapist in an EC setting. Two coaches had previous experience as a coach or consultant; however, only one coach reported receiving training about coaching before her involvement in the present study.

Face-to-face coaching sessions consisted of a classroom observation and a debriefing meeting where the coach and teacher reflected on EI implementation, the coach provided performance feedback to the teacher, and the coach supported the teacher's development of embedded-instruction implementation goals and associated action plans. These coaching sessions had three parts: an observation, a debriefing meeting that included performance feedback, and a follow-up email. The alternate coaching sessions had all the components of the debriefing meeting. The mean duration of coaching observations was 73.9 min (SD = 19.5) and for the debriefing meetings, 39.3 min (SD = 12.1).

After workshops, project staff at each site gave teachers in the self-coaching condition a 2-hr orientation to practice-based coaching and the self-coaching website. At this orientation session, teachers were supported to develop an initial EI implementation goal and an accompanying action plan. They subsequently received weekly e-mail prompts for 16 weeks from project staff to engage in self-coaching. The email included a "tip of the week" related to EI implementation and a link to related website resources for use in self-coaching. Through web-based analytics, teachers' use of the self-coaching website was monitored, including the number of times they visited the site, the number of action plans they developed, and their use of the EI resources on the website. Self-coaching dose varied, with two teachers implementing all components of self-coaching, seven teachers implementing most components, and two teachers implementing only one component.

The 12 teachers in the BAU condition received PD offered by their districts. We gathered information from teachers about the type of BAU PD that they experienced during the study. Of these 12 teachers, 10 reported receiving workshops. The mean number of workshops that they attended was 8.8 (SD = 10.2). Other forms of BAU PD that teachers reported receiving were a semester-long course (one teacher), conferences (six teachers attended one 1-day conference), communities of practice (two teachers attended 1-hr sessions for 14 and 7 weeks each), on-site consultation (two teachers received one

consultation each), and observing in other teachers' classrooms (two teachers, one occasion each). Except for the number of workshops attended, there generally were no differences in the amount of BAU PD across the three districts. During the course of the study, no teacher in the BAU condition reported receiving any form of PD on EI or the key EI practices. Only one teacher reported receiving coaching, and this centered on the classroom schedule. Teachers in the BAU condition participated in workshops at the end of the school year at each site after the intervention ended, were provided the implementation guides and materials, and were given access to the self-coaching website.

Teachers in all conditions received PD provided by their school districts during the study. The TfT PD interventions were in addition to BAU PD for teachers in those conditions.

Implementation Fidelity

Data were collected to describe the fidelity with which workshops and both variants of coaching were implemented with several project-developed and validated measures. During all workshop sessions, an observer not involved in experimental intervention activities rated the fidelity with which the workshop content and formats were implemented as planned, using indicator checklists. Mean implementation fidelity for workshops was 98.6%, 95.5%, 99.4%, and 93.6% for the overview, planning, implementing, and evaluating modules, respectively. On-site coaching sessions were monitored for adherence to the coaching protocol by a trained observer who was not involved in experimental intervention activities. This observer watched the coach conduct an observation and debrief/feedback session and scored a fidelity checklist for 28% of randomly selected coaching sessions. Average fidelity to the on-site coaching protocol across these sessions was 96.1% (range: 77%–100%). Agreement between indicators on the coaching session log completed by the coach and the indicators on the coaching fidelity checklist completed by the second observer was 95% (range: 78%–100%).

For the PD condition comprising self-coaching with web-based support, we monitored the fidelity with which a self-coaching orientation session was delivered to teachers by a project staff member at each site. Average implementation fidelity for self-coaching training was 97.2% (range: 91.7%–100%). In addition, a project staff member not involved in experimental intervention activities monitored the fidelity with which another project staff member composed a weekly e-mail reminder to teachers in the self-coaching condition. An average of 15 emails were delivered to and read by each teacher in the self-coaching condition. Mean fidelity to the self-coaching email protocol was 99% (range: 97%–100%).

Dependent Measures

Proximal (teacher) and distal (child) dependent measures were used in the present study. All dependent measures data were collected by project personnel who were naïve to teachers' and children's experimental conditions. Each measure is described below. We collected interobserver agreement data for at least 33% of each dependent measure administered at each measurement occasion.

Teacher EI implementation measures. The Learning Targets Rating Scale–Research Version 2.0 (LTRS; Snyder, McLaughlin, et al., 2009) is a summated, judgment-based rating scale to evaluate the quality of priority EI learning targets. Teachers wrote EI learning targets for target children, and we rated these learning targets using the LTRS. These same learning targets were subsequently used to code teachers' implementation of EI learning trials via the Embedded Instruction Observation System (EIOS; Snyder, Crowe, et al., 2009). For each administration of the LTRS, each teacher wrote three to four learning targets for the target children in the classroom. Each learning target was rated by a trained coder using 16 LTRS quality indicators. The quality indicators were organized under 6 domains: behavior statement ($v = 4$), age-appropriateness ($v = 2$), functionality ($v = 3$), generality ($v = 2$),

instructional context ($v = 2$), and measurability ($v = 3$). Dichotomous scoring is used for each indicator (0 = *does not meet indicator criteria* or 1 = *meets indicator criteria*). Scores are reported as the percentage of quality indicators met. An example of a learning target that meets all the quality indicators is "Jose will count up to five objects using 1-to-1 correspondence following a verbal or visual prompt in three activities (small group, centers, and outdoor play) once each day for 5 consecutive days." An example of a learning target that meets only two of the quality indicators is "Jose will count objects."

Teachers' LTRS scores in the present study are percentage scores averaged across the target children in each teacher's classroom. A generalizability study based on present study data showed minimal error variance due to raters, with *G* coefficients ranging from 0.74 to 0.90 (McLaughlin, Snyder, & Algina, 2016).

The EIOS (Snyder, Crowe, et al., 2009) is a continuous-event observational coding system that was used to quantify the occurrence and accuracy of EI learning trials that a teacher implemented with target children during child-initiated, teacher-directed, routine, and transition activities in the preschool classroom. These activities were videotaped, and trained observers applied occurrence and accuracy codes as they reviewed videotapes. On average, the mean duration of EIOS video coded for all teachers across data collection occasions was 74 min (range: 19–131 min). Occurrence was an event code used to quantify the number of EI learning trials that teachers implemented with target children. Accuracy codes were also event codes linked to the components of an EI learning trial. A trial was defined by an instructional sequence that includes (a) an antecedent to set the occasion for a child behavior; (b) a child behavior (skill or behavior targeted for instruction); (c) a consequence for a correct behavior; or (d) an error correction, if needed. Accuracy was defined as the number of trials that were procedurally correct (teacher implemented the antecedent; error correction, if needed; and consequence). The occurrence and accuracy of learning trials were obtained by summing the number of learning trials across learning targets and target children in each teacher's classroom, dividing this number by the duration of the coded video footage, and converting the scores to the rate of EI trials per teacher. We report rate of learning trials per 15 min. Occurrence agreement was obtained for 36% of all EIOS observation sessions. Mean agreement across all coded sessions was 92% ($SD = 16$). Interrater agreement for accuracy was obtained for 33% of all EIOS observation sessions. Mean agreement across all coded sessions was 89% ($SD = 13$).

Child outcome measures. The EIOS was also used to quantify the rate at which child learning target behaviors occur when teachers implement EI learning trials. This measure directly aligns with teachers' implementation of EI learning trials. Standardized assessments of language, preacademic concepts, early literacy, and social and behavior skills were administered. The standardized child outcome measures administered to children by trained staff naïve to experimental condition were the Bracken Basic Concept Scale–Third Edition: Receptive (BBCS-3R; Bracken, 2006), the Preschool Language Scale–4 (PLS-4; Zimmerman, Steiner, & Pond, 2002), and the Test of Early Reading Ability–Third Edition (TERA-3; Reid, Hresko, & Hamill, 2001). Teachers completed the Preschool and Kindergarten Behavior Scales–2 (PKBS-2; Merrell, 2002) for each target child.

Interobserver agreement was obtained for 39% of all TERA-3 administrations, 32% of all PLS-4 administrations, and 41% of all BBCS-3R administrations. During an agreement session, one trained assessor administered the assessment, and a second trained assessor watched the administration live or via video. Assessors scored the adminstration seperately. Interobserver agreement at the item level was calculated by dividing the number of agreements by the total number of agreements and disagreements (i.e., total items administered) and multiplying by 100. Mean interrater agreement was 99% ($SD = 2$)

for the TERA-3, 98% (*SD* = 3) for the PLS-4, and 99% (*SD* = 1) for the BBCS-3R across pre- and postadministrations.

Social validity measures. Teachers in each TfT PD intervention completed 12-item workshop evaluation forms focused on the workshop content, format/organization, and trainer. Each item was scored with a 4-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (4). These teachers also completed Intervention Rating Profiles (IRPs) revolving around EI (27 items; 6 subscales) and IRPs centered on either on-site coaching or self-coaching (10 items on each IRP), consistent with their experimental condition. The IRP for EI was adapted from the 20-item IRP (Witt & Martens, 1983) and had six subscale dimensions: acceptable practice that benefits children ($v = 7$), poses no risk to children ($v = 4$), practical amount of time required for implementation ($v = 4$), does not have negative effect on other children ($v = 3$), does not require technical skill to implement ($v = 2$), and compatibility of EI in the context of the preschool curriculum ($v = 7$). The IRP for on-site coaching and IRP for self-coaching were adapted from the 15-item IRP (Martens, Witt, Elliott, & Darveaux, 1985). Each item on each IRP used in the present study was scored with a 6-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (6).

Data Collection and Statistical Analyses

Data were collected in waves: preintervention (Wave 1); after workshops were completed (Wave 2); during the last month of coaching (Wave 3); and postintervention, 4 to 5 weeks after coaching ended (Wave 4). LTRS data were collected at each wave of data collection; EIOS data were collected at Waves 1, 2, and 4. Child measures were collected at Wave 1 and Wave 4. IRP data were collected at Wave 4 (see Figure 1).

We conducted analyses using data from the present study sample to evaluate internal consistency score reliability for each child outcome measure. Cronbach's alpha at pre- and posttest was, respectively, .969 and .973 for the BBCS-3, .943 and .952 for the PLS-4 Auditory Composite subscale, .950 and .945 for the PLS-4 Expressive Composite subscale, .963 and .959 for the PKBS-2 Social Skills subscale, .947 and .953 for the PKBS-2 Problem Behavior subscale, and .825 and .834 for the TERA-3.

Analysis of covariance was used to analyze the Wave 4 data. Preintervention (Wave 1) scores were covariates in each analysis. Results for interaction and main effects were used if the Covariate × Treatment interaction was statistically significant. If the interaction term was not statistically significant, results are main effects from the reduced model. Glass's Δ (1976) was the effect size measure used. PROC GLM in SAS 9.4 was used to analyze variables from LTRS and EIOS. Because target children were "nested" within each teacher's classroom, PROC SURVEYREG in SAS 9.4 was used to analyze variables from standardized child measures. A single-level model was used to estimate parameters, and Taylor series linearization (McNeish, Stapleton, & Silverman, 2017) was used to correct inference for clustering of children in teachers. In the Results section, tests that are statistically significant at $\alpha = .05$ and have $\Delta \geq |0.20|$ are described as statistically significant and noteworthy. Tests that are statistically significant at $\alpha = .25$ and have $\Delta \geq |0.20|$ are described as noteworthy. The "relaxed" alpha value for the child outcome measures was justified given that the present study was a Goal 2 potential efficacy trial to evaluate the promise of the two TfT PD interventions (Institute of Education Sciences, 2006).

Attrition

Thirty-six teachers were enrolled in the study, and 35 completed it and participated in all follow-up (Wave 4) assessments. One teacher from the self-coaching PD intervention condition withdrew after participating in workshops and approximately 5 weeks of coaching because of changes made by school district administrators to her classroom staffing

structure. During the course of the study, six children moved out of district or to different schools within the district, and the three target children in the teacher's classroom who withdrew were not available for follow-up, resulting in 97 of 106 enrolled children who participated in postintervention assessments.

Results

Results are provided for each primary research question. Descriptive statistics are shown in Table 3.

Quality of EI Priority Learning Targets

The descriptive statistics show that teachers who participated in either TfT PD intervention wrote higher-quality learning targets after workshops (Wave 2) and continued to show increases in the quality of their written learning targets at Waves 3 and 4. We found statistically significant and noteworthy differences in the quality of their written Wave 4 EI priority learning targets as compared with teachers in the BAU PD condition: TfT on-site coaching versus BAU PD, $t(30) = 3.69$ ($p = .001$, $\Delta = 1.41$), and TfT self-coaching versus BAU PD, $t(30) = 3.64$ ($p = .001$, $\Delta = 1.50$). No statistically significant or noteworthy differences were identified between teachers who participated in the two TfT PD conditions, $t(30) = -0.22$ ($p = .826$, $\Delta = -0.09$).

Occurrence and Accuracy of EI Learning Trials

The descriptive statistics show that teachers who participated in either TfT PD intervention implemented more EI learning trials and more accurate EI trials during Wave 2 data collection, which occurred after workshops were completed. By Wave 4, however, teachers in the TfT on-site coaching condition were implementing more trials and more accurate trials than teachers in either the TfT self-coaching or BAU condition. We found statistically significant and noteworthy differences in learning trial occurrence and accurate implementation of embedded learning trials for teachers in the TfT on-site coaching condition when compared with teachers in either TfT condition: self-coaching—occurrence, $t(31) = 2.07$ ($p = .047$, $\Delta = 1.22$), and accuracy, $t(31) = 2.20$ ($p = .036$, $\Delta = 1.90$); BAU—occurrence, $t(31) = 2.31$ ($p = .028$, $\Delta = 1.35$), and accuracy, $t(31) = 2.56$ ($p = .016$, $\Delta = 2.2$). We found no statistically significant differences in occurrence and accuracy of learning trials between teachers who participated in TfT self-coaching and BAU PD: occurrence, $t(31) = 0.22$ ($p = .830$, $\Delta = 0.13$), and accuracy, $t(31) = 0.35$ ($p = .729$, $\Delta = 0.30$).

Occurrence of Child Learning Target Behavior

The descriptive statistics show that the learning target behaviors for children whose teachers who participated in either TfT PD condition occurred more frequently during Wave 2 data collection, which occurred after workshops were completed by their teachers. By Wave 4, however, children whose teachers were in the TfT on-site coaching condition were demonstrating the learning target behaviors more frequently than children whose teachers were in either the TfT self-coaching or BAU condition. We found statistically significant and noteworthy increases in the occurrence of the skills or behaviors specified in their learning targets during EI learning trials at Wave 4 for children whose teachers were in the TfT on-site coaching condition as compared with children whose teachers were in either TfT self-coaching, $t(31) = 2.31$ ($p = .028$, $\Delta = 1.75$), or BAU, $t(31) = 2.73$ ($p = .010$, $\Delta = 2.09$). There were no statistically significant differences in the occurrence of skills for children whose teachers were in the TfT self-coaching versus BAU conditions, $t(31) = 0.45$ ($p = .658$), although the effect size was small to moderate ($\Delta = 0.34$).

Standardized Child Assessments

Children whose teachers participated in either TfT PD intervention had statistically

Table 3. Sample Sizes, Means, Standard Deviations, and Adjusted Means by Variable, Data Wave, and Condition.

	On-site coaching				Self-coaching				BAU control			
Instrument: Variable—Wave	*N*	*M*	*SD*	Adj. *M*	*N*	*M*	*SD*	Adj. *M*	*N*	*M*	*SD*	Adj. *M*
LTRS: Total[a]												
1	12	57.9	8.9		12	48.5	10.0		11	56.3	8.1	
2	12	66.3	8.4		12	64.5	12.4		12	53.8	10.1	
3	12	70.9	8.2		11	71.1	10.5		12	56.6	9.8	
4	12	71.3	7.8	70.5	11	70.0	9.9	71.4	12	56.1	10.2	56.2
EIOS[b]												
Occurrence												
1	12	1.8	1.6		12	2.3	2.2		12	2.7	2.2	
2	12	1.9	1.7		11	2.8	3.2		12	1.9	1.7	
4	12	4.2	3.5	4.2	11	2.1	1.2	2.1	12	1.9	1.7	1.9
Accurate												
1	12	0.7	1.2		12	1.0	1.0		12	1.3	1.5	
2	12	0.9	0.9		11	1.6	2.8		12	1.1	1.1	
4	12	2.9	3.0	3.0	11	1.2	1.1	1.2	12	0.9	0.9	0.9
Child Behavior												
1	12	0.5	1.1		12	0.7	0.6		12	1.2	1.3	
2	12	0.7	0.9		11	1.6	2.8		12	0.9	0.9	
4	12	2.8	2.7	2.8	11	1.1	1.0	1.1	12	0.9	1.0	0.8
TERA-3: RQ[c]												
1	28	78.7	10.2		27	80.1	10.1		30	82.3	10.3	
4	26	80.7	13.8	82.1	24	82.9	10.9	83.4	28	77.0	11.9	76.0
PLS-4[d]												
Auditory												
1	35	71.4	16.5		36	77.6	15.8		35	73.2	16.5	
4	32	74.9	16.9	77.2	33	81.8	15.2	79.2	33	72.5	15.1	73.4
Expressive												
1	35	74.1	18.1		36	78.9	14.8		35	73.5	15.6	
4	32	74.3	16.0	75.9	33	78.7	15.1	76.1	33	74.0	14.7	75.9
BBCS-3R: SR[e]												
1	33	80.2	14.4		36	82.5	13.0		31	82.4	15.0	
4	30	83.1	17.5	84.1	33	87.5	14.8	87.3	29	83.8	17.3	84.0
PKBS-2[f]												
SS												
1	35	82.4	18.6		36	86.6	19.6		35	88.3	22.3	
4	32	92.4	18.4	94.6	33	94.1	20.0	93.2	34	91.9	19.1	90.1
PB												
1	35	98.1	11.0		36	100.6	14.0		35	100.9	14.9	
4	32	99.2	12.8	100.3	33	97.6	15.9	96.6	34	102.2	14.5	101.7

Note. BAU = business as usual.

[a]Learning Targets Rating Scale–Research Version 2.0 (Snyder, McLaughlin, et al., 2009): scores reported are percentages of indicators met. [b]Embedded Instruction Observation System (Snyder, Crowe, et al., 2009): scores reported are rates of learning trials for teachers per 15 min. [c]Test of Early Reading Ability–Third Edition (Reid, Hresko, & Hamill, 2001): RQ = reading quotient. [d]Preschool Language Scale–4: Auditory Composite and Expressive Composite subscales (Zimmerman, Steiner, & Pond, 2002). [e]Bracken Basic Concept Scale–Third Edition: School Readiness (SR) subscale (Bracken, 2006). [f]Preschool and Kindergarten Behavior Scales–2: Social Skills (SS) and Problem Behavior (PB) subscales (Merrell, 2002).

significant and noteworthy differences on TERA-3 reading quotient scores when compared with children whose teachers received BAU PD: TfT on-site coaching versus BAU PD, $t(35) = 2.52$ ($p = .016$, $\Delta = 0.59$), and TfT self-coaching versus BAU PD, $t(35) = 3.08$ ($p = .004$, $\Delta = 0.72$). There were no statistically significant or noteworthy differences in TERA-3 reading quotient scores for children whose teachers received TfT on-site coaching versus TfT self-coaching, $t(35) = -0.54$ ($p = .594$, $\Delta = -0.12$). There were statistically significant and noteworthy differences on the PLS-4 Auditory Composite subscale for children whose teachers received TfT on-site coaching and TfT self-coaching versus children whose teachers received BAU PD, $t(35) = 2.15$ ($p = .039$, $\Delta = 0.35$), and noteworthy differences for TfT on-site coaching versus BAU PD ($p = .208$, $\Delta = 0.23$). Group differences on the PLS-4 Expressive Communication subscale were not statistically significant, and effect sizes were near zero. On the BBCS-3R, there were noteworthy differences on the School Readiness subscale for children whose teachers received TfT self-coaching versus children whose teachers received BAU PD ($p = .077$, $\Delta = 0.22$) and between children whose teachers received TfT self-coaching and children whose teachers received TfT on-site coaching ($p = .160$, $\Delta = -0.22$). For the PKBS-2, there were noteworthy differences on the Problem Behavior subscale for children whose teachers received TfT self-coaching when compared with children whose teachers received BAU PD ($p = .123$, $\Delta = -0.34$) and between children whose teachers received TfT on-site coaching and those whose teachers received TfT self-coaching ($p = .181$, $\Delta = 0.25$). For the Social Skills subscale, there were noteworthy differences for children whose teachers received TfT on-site coaching versus BAU PD ($p = .238$, $\Delta = 0.20$).

Social Validity of PD Interventions

With respect to the evaluation of workshop content, format/organization, and trainer, the mean score for the 12-item measure averaged across the three sites for each module was 3.9 (out of 4), with a range from 3 to 4. Overall, teachers reported that they strongly agreed that the workshop module content was applicable for them, appropriately targeted to their abilities and skills, and would be useful in their daily work with young children with learning challenges and that EI was feasible to use in preschool classrooms. They strongly agreed that the workshops were well organized and well sequenced; the learning objectives for the workshop were clearly stated and were accomplished; and the trainer was prepared, effective, and enthusiastic.

With respect to their evaluations of on-site coaching versus self-coaching, teachers in the on-site coaching condition agreed more strongly with every item on the IRP scale when compared with ratings by teachers in the self-coaching condition. The overall mean rating for the 10 IRP items was 5.6 for on-site coaching ($SD = .05$) and 3.8 for self-coaching ($SD = 1.1$). Table 4 shows the scores for each IRP item for the two coaching conditions.

Social Validity of EI

For the EI IRP, teachers strongly agreed that EI was a practice that benefited children ($M = 5.4$, $SD = 0.8$) and posed no risk to children ($M = 5.1$, $SD = 0.7$). They agreed that the time needed to implement EI was practical ($M = 4.2$, SD = 1.2), that it posed no risk to other children ($M = 4.8$, $SD = 1.0$), and that it was compatible with the general preschool curriculum ($M = 4.5$, $SD = 0.6$). They somewhat disagreed that EI did not require technical skill to implement ($M = 4.5$, $SD = 0.6$).

Discussion

We conducted a three-group randomized controlled evaluation to examine the potential efficacy of two variants of the TfT PD intervention, compared with BAU PD, on preschool teachers' implementation of EI practices and child developmental and learning outcomes. Findings related to the fidelity of implementation of the TfT PD interventions showed that workshops and both variants of coaching were feasible to implement with a high level of

Table 4. Means (Standard Deviations) for Intervention Rating Profile for Two Variants of Coaching.

Item	On-site coaching	Self-coaching
Most teachers would find [on-site or self-coaching] suitable for planning, implementing, and evaluating embedded instruction.	5.6 (0.07)	3.3 (1.6)
Most teachers would think [on-site or self-coaching] is a valuable use of their time.	5.5 (0.07)	3.9 (1.1)
[On-site or self-coaching] is practical in terms of the amount of time required.	5.5 (0.07)	3 (1.7)
[On-site or self-coaching] helps teachers implement embedded instruction with fidelity.	5.8 (0.05)	3.8 (1.8)
Teachers are likely to participate in [on-site or self-coaching] because it requires no prior technical skills.	5.3 (0.08)	3.8 (1.7)
[On-site or self-coaching] helps teachers use embedded instruction in their classroom.	5.8 (0.04)	4.6 (1.4)
Most teachers would be satisfied with the process of [on-site or self-coaching].	5.5 (0.07)	4 (1.4)
[On-site or self-coaching] increases teachers' knowledge and skills about embedded instruction.	5.7 (0.07)	4.1 (1.4)
Most teachers would prefer to have [on-site or self-coaching] to implement evidence-based practices in their classrooms.	5.4 (0.08)	3.7 (1.1)
Overall, [on-site or self-coaching] is beneficial for teachers.	5.8 (0.05)	4.2 (1.3)
Overall mean rating	5.6 (0.05)	3.8 (1.1)

Note. Rating scale for items: *strongly disagree* (1) to *strongly agree* (6).

fidelity in controlled conditions (i.e., when implemented by project staff and trained coaches). Our findings provide evidence for fidelity of implementation practices, defined as the methods and procedures used by implementation agents (e.g., workshop trainers, coaches) to promote end users' adoption and use of EBPs (Dunst, Trivette, & Raab, 2013). PD intervention components in the present study, including the coaching components, were designed as enlightened forms of PD, which have been identified as important competency drivers in active implementation science frameworks. Our PD intervention was grounded in theoretical frameworks asserting that teachers are more likely to implement and sustain changes in practice when PD is concrete and specific, aligned with curricular content, connected to existing "craft" knowledge, focused on instructional challenges, and a good "contextual fit" with their classroom contexts (Hiebert, Gallimore, & Stigler, 2002; Stigler & Hiebert, 2009). Our findings also demonstrated that an evidence-informed, practice-based coaching framework (Snyder, Hemmeter, & Fox, 2015) with structured and replicable coaching protocols could be implemented with fidelity by trained coaches.

Regarding teachers' EI intervention fidelity (Dunst et al., 2013), the two variants of the TfT PD intervention that teachers received were associated with noteworthy increases in the quality of their written priority learning targets to guide EI implementation, as compared with those of teachers in the BAU condition. However, the TfT intervention that included on-site coaching was differentially effective for improving the rate and accuracy of teachers' implementation of EI learning trials with children, as compared with either the TfT intervention that included self-coaching or the BAU PD condition. In addition, a statistically significant interaction effect showed that teachers in the TfT on-site coaching condition who implemented a low number of EI learning trials preintervention made greater gains in the number of learning trials implemented by the end of the study when compared with teachers in the self-coaching or BAU PD conditions who also implemented a

low number of learning trials preintervention. These data suggest that coaching in the practice context might be particularly important for teachers who are implementing a low number of EI learning trials before participation in PD.

Coaching in the practice context might be particularly important for teachers who are implementing a low number of EI learning trials before participation in PD.

Findings from the present study are consistent with those of Hemmeter, Snyder, Fox, and Algina (2016). These authors found that teachers who received a similar PD intervention (workshops, implementation guides and materials, and on-site practice-based coaching) implemented significantly more Pyramid Model intervention practices with fidelity than did teachers who received BAU PD. The Pyramid Model is a framework of evidence-based environmental, interactional, and instructional practices that teachers use to promote young children's social-emotional competence and prevent or address challenging behavior. Findings from the present study also are consistent with those from 45 randomized controlled trials reviewed with procedures described by Snyder and colleagues (2011). The reviewed studies were published from 2006 to 2014, and PD for EC practitioners was the independent variable. The PD interventions included two key components: detailed, concrete, and specific information about practices with explicit descriptions and demonstrations of these practices (often through workshops or learning objects on websites) and individualized support and feedback (often referred to as coaching) to implement the practices. The authors reported that when the key components were combined, the studies showed effects for improving dimensions of classroom environmental quality (11 of 13 studies) and instructional quality (37 of 39 studies; Snyder et al., 2011). Fidelity of implementation of all PD intervention components was measured in only 18% of the 45 studies, however. Only five studies compared variants of coaching, and none compared on-site coaching with self-coaching.

Therefore, our study contributes to third-generation research by identifying and measuring the fidelity of implementation of PD intervention components, including the coaching components, that have the potential to be differentially efficacious for supporting early learning practitioners to implement different EBPs under certain conditions. For example, workshops that include opportunities for practice and feedback might be sufficient for helping teachers learn to implement certain EI practices (e.g., writing quality learning targets). Workshops and follow-up support with performance feedback in the practice context (e.g., coaching) might be needed to ensure fidelity of implementation of other EI practices (e.g., implementing more EI trials and more accurate trials), particularly for teachers who are implementing few learning trials.

Children whose teachers participated in TfT with on-site coaching had more frequent and more accurate EI learning opportunities than children whose teachers participated in either TfT with self-coaching or BAU PD. These children demonstrated the skills and behaviors specified in their priority learning targets at higher rates than did children whose teachers participated in the other two conditions. These child learning outcomes were those most directly related to their teachers' implementation of EI learning trials, demonstrating the important research-to-practice link noted between practice implementation and child learning outcomes (Odom, 2009).

Opportunities to learn priority skills in the context of classroom activities and routines and the provision of systematic instruction during these learning opportunities are hallmarks of EI for young children (Snyder, Rakap, et al., 2015). Contextualized learning opportunities need to target priority skills and behaviors that align with children's IEP goals and general preschool curricular content to support access to and participation in inclusive learning environments (Snyder et al., 2013). Findings from our study suggest that teachers need explicit training followed by in

situ implementation supports such as coaching to increase the number of EI learning opportunities provided to young children with disabilities and to ensure that effective systematic instructional procedures are implemented with fidelity.

Teachers' participation in both TfT PD interventions was associated with generally modest but noteworthy gains in children's early literacy and receptive language skills as measured on standardized child assessments when compared teachers who received BAU PD. Notably, post hoc analyses of children's learning targets over the course of the study showed that 82% of them focused on preacademic, literacy, or communication skills. With respect to the other child outcome measures, there were mixed results, slightly favoring children whose teachers received the TfT with self-coaching relative to those whose teachers who received TfT with on-site coaching or BAU PD. While acknowledging the importance of demonstrating intervention effects on distal child outcomes, we recognize the mismatch between contextualized opportunities to learn behaviors and skills and the decontextualized nature of standardized assessments. With standardized assessments, not only are priority learning target skills measured, but other skills not explicitly targeted for instruction are measured. In addition, due to the end of the school year, child assessments were administered in close proximity to when intervention ended for teachers. More robust child effects might have been obtained if it had been possible to conduct additional follow-up child assessments.

Social validity data showed that teachers were favorable about the acceptability, feasibility, and utility of EI and the TfT PD interventions. Nevertheless, on-site coaching was rated more positively than self-coaching on all social validity items on the IRP. This finding is likely explained by the strength of the collaborative partnerships that teachers and coaches reportedly established to support teachers' implementation of EI practices in the classroom (Snyder, Hemmeter, & Fox, 2015). Teachers in the self-coaching condition did not have support for practice implementation in their classroom and needed to rely on themselves to self-monitor and self-evaluate their EI practice implementation. These findings warrant additional study given the differences in cost for on-site coaching versus self-coaching. Additional third-generation research is needed to explore differences in practice implementation and child outcomes for different doses and variants of PD and coaching and for different practitioners.

On-site coaching was rated more positively than self-coaching on all social validity items.

The present study has several limitations that should be acknowledged. First, we used project-developed measures to evaluate teachers' EI intervention fidelity. Although score reliability or interrater agreement data were generated with data from the study sample and were adequate, additional psychometric evidence is needed for both measures. Second, although teachers were randomly assigned to experimental conditions and were comparable at baseline on relevant teacher and classroom variables, they were volunteers who consented to participate in the study. We do not know if these teachers or their classrooms differed on measured or unmeasured variables from nonstudy preschool teachers or their classrooms in the three school districts in which the study was conducted. Third, given sample sizes at the teacher and child levels, we did not use hierarchical analyses to analyze child data. Estimates of effects on child developmental and learning outcomes should be interpreted with caution pending replication with larger samples of teachers and children and the use of analyses that further accommodate the nested nature of the data.

The major contributions from this study can inform future PD, coaching, EI practice, and third-generation research. Data from the present study contribute notably to a growing body of empirical evidence related to identifying features of PD that are differentially efficacious for supporting EC practitioners to implement EBPs with fidelity to support child development and learning,

particularly for young children with or at risk for disabilities. Additional research with larger samples of teachers and children is being conducted to further evaluate the efficacy of the TfT PD interventions for supporting preschool teachers' implementation of EI practices. Larger efficacy trials will permit deeper analyses of the mediational relationships among implementation fidelity, intervention fidelity, and child developmental and learning outcomes as well as moderators of teacher implementation and child outcomes.

With respect to PD, findings from the present study support conceptualizations about components of efficacious PD as suggested by Desimone (2009) and Snyder et al. (2011). That is, the PD in the present study had a specific content focus on a set of EI practices that was made explicit to teachers; workshops involved active learning strategies and collective participation; and workshops were delivered as a coherent series rather than as episodic trainings. A coaching framework and systematic coaching protocols centered on practice implementation were used (Snyder, Hemmeter, & Fox, 2015). Although additional research is needed to identify optimal doses of PD, including coaching, findings from the present study suggest that one-shot workshops would not be sufficient to support teachers' implementation of EI practices and should be avoided when practice implementation is the desired PD outcome focus (Snyder et al., 2011).

Based on the social validity data from the present study, TfT should be useful in practice. We engaged with researchers, practitioners, families, and EC program administrators in iterative processes of development, validation, and evaluation of TfT PD implementation and EI intervention practices. As an evidence-based and recommended practice (Division for Early Childhood, 2014), the use of EI to support children's contextualized engagement and learning and their access to the general preschool curriculum should enhance the quality of inclusive learning experiences for preschool children with disabilities (U.S. Department of Health and Human Resources & U.S. Department of Education, 2015).

Studies such as this one demonstrate important linkages among evidence-based PD, fidelity of implementation of EBPs, and child learning outcomes. Our study contributes to ongoing efforts to address the research-to-practice gap and the link between implementation and outcomes. As Odom (2009) noted, from the perspective of implementation science, the "tie that binds" is EBPs, implementation science, and outcomes for young children with disabilities.

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