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A Randomized Trial of Embedded Instruction Training and Coaching for Preschool Teachers: Impacts on Teacher Implementation and Child Outcomes

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Abstract

The increasing number of children with disabilities served in inclusive preschool classrooms has heightened the need for instructional approaches that support learning during naturally occurring classroom activities and routines. Embedded instruction (EI) is a naturalistic teaching approach that allows teachers to provide systematic learning opportunities for children with disabilities within everyday classroom contexts. This study examined the effects of two professional development approaches, Supporting Early Education through Embedded Instruction (SEED-EI) workshops and SEED-EI workshops combined with practice-based coaching, on preschool teachers' implementation of EI and the learning outcomes of children with disabilities. A randomized controlled design was used with 36 preschool teachers and 36 children with disabilities. Teachers were randomly assigned to one of three conditions: business-as-usual (BAU), SEED-EI workshops, or SEED-EI workshops plus coaching. Results indicated that teachers who participated in the SEED-EI interventions implemented EI practices more frequently and with greater accuracy than teachers in the BAU condition, with the highest levels observed among teachers who received coaching. Children whose teachers participated in the intervention conditions demonstrated greater improvements in target behaviors, particularly in the coaching condition. Findings highlight the importance of sustained, job-embedded professional development supports for improving the implementation of evidence-based instructional practices in inclusive preschool classrooms.

Keywords: embedded instruction; inclusive preschool; professional development; practice-based coaching; teacher implementation; children with disabilities; evidence-based practices; special education

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1. Introduction

Inclusive education has expanded across many regions, including North America and Europe, as policies increasingly emphasize educating young children with disabilities in the least restrictive environments (e.g., Odom et al., 2011; European Agency for Special Needs and Inclusive Education, 2018). Consequently, growing numbers of children with

disabilities now receive services in inclusive early learning classrooms alongside their typically developing peers (Pellegrini & Vivanet, 2021). Research consistently shows that when appropriate supports are provided, children with disabilities demonstrate positive developmental, social, and academic outcomes compared with peers receiving services in segregated settings (Lawrence et al., 2016; Odom et al., 2011). However, placement in inclusive settings alone does not ensure meaningful engagement or learning. Recommended practices emphasize that inclusion should involve both access to classroom activities and active participation within those activities (Division for Early Childhood of the Council for Exceptional Children, 2014). Participation refers to children's opportunities to engage, interact, and learn during everyday classroom routines and interactions. Evidence suggests that children's engagement and learning are enhanced when teachers intentionally provide individualized instructional opportunities during ongoing classroom activities (Boat et al., 2010; Cheung et al., 2023). Thus, the instructional practices implemented by teachers play a critical role in supporting the development and learning of children with disabilities.

One instructional approach widely recommended for supporting individualized learning within inclusive early childhood environments is embedded instruction (EI; Division for Early Childhood of the Council for Exceptional Children, 2014). Embedded instruction is a naturalistic instructional approach in which opportunities to learn priority skills are intentionally incorporated into children's everyday activities and routines by adults who regularly interact with the child (P. Snyder, 2025). Within EI, teachers plan and deliver brief, systematic instructional episodes during ongoing classroom interactions so that children can practice targeted skills in meaningful contexts. By integrating instruction into naturally occurring classroom activities, EI promotes learning that is closely connected to children's interests, classroom expectations, and everyday interactions with peers and adults (P. A. Snyder et al., 2015b).

Embedded instruction is characterized by several defining features that guide its implementation (P. A. Snyder et al., 2015b). Instruction focuses on priority skills that support children's access to and participation in classroom environments and align with individualized education program (IEP) goals and broader preschool curriculum expectations (Bruder & Ferreira, 2022). Learning opportunities occur within typical classroom routines, activities, and transitions, often initiated by the child or based on the child's focus of attention. Teachers provide natural or logical consequences following children's responses and collect data to monitor both implementation and children's learning progress (Rakap, 2017). These features support individualized instruction that promotes children's engagement, participation, and skill development within inclusive early childhood settings (P. Snyder, 2025).

A growing body of research supports the effectiveness of EI for improving developmental and learning outcomes among young children with disabilities. Systematic reviews and meta-analyses have found that EI is associated with positive effects on children's acquisition of targeted skills across developmental domains (Gulboy et al., 2023; Rakap & Parlak-Rakap, 2011; P. A. Snyder et al., 2015b). Despite the strong evidence base, research indicates that preschool teachers often implement embedded learning opportunities (ELOs) infrequently in inclusive classrooms. Observational studies have found that teachers provide relatively few EI trials during everyday classroom routines and activities (Balikci et al., 2025; Noh et al., 2009; Pretti-Frontczak & Bricker, 2001; Rahn et al., 2019), highlighting a persistent research-to-practice gap.

Professional development has been identified as an important mechanism for supporting practitioners' implementation of evidence-based practices. Implementation science frameworks emphasize that training alone is often insufficient to produce sustained changes in practitioner behavior; instead, practitioners require ongoing supports that help trans-

late knowledge into practice (Fixsen et al., 2019). Research syntheses indicate that PD interventions can improve practitioners' implementation of instructional practices and may also influence related child outcomes (Brunsek et al., 2020; Egert et al., 2018). One form of job-embedded professional development that has received increasing attention is practice-based coaching (PBC). PBC involves collaborative goal setting, observation of practice, and reflective feedback cycles to support implementation (P. A. Snyder et al., 2015a; P. Snyder et al., 2022). Evidence suggests that coaching can enhance practitioners' use of evidence-based practices, particularly when combined with workshops or training (Elek & Page, 2019; Kraft et al., 2018; Rakap et al., 2025).

Several studies have examined professional development interventions designed to support teachers' implementation of EI practices P. Snyder et al. (2018) found that teachers who received workshops and on-site coaching implemented ELOs more frequently and with greater fidelity than those receiving business-as-usual professional development, with corresponding improvements in child outcomes. More recently, P. A. Snyder et al. (2026) reported similar findings, with teachers receiving on-site coaching demonstrating higher-quality EI implementation and children showing higher levels of engagement and targeted skill use. Single-case design studies provide further support. Coaching-supported professional development has been shown to improve teachers' implementation fidelity and increase children's correct responding in inclusive classrooms (Ai et al., 2024; Rakap et al., 2024). Additional studies have documented improvements in children's engagement, learning, and maintenance of skills over time (Rakap & Balikci, 2025), as well as emerging evidence supporting innovative approaches such as AI-supported self-coaching (Balikci, 2026). Together, these findings suggest that coaching-supported professional development can improve teachers' implementation of EI and contribute to positive child outcomes.

Although existing research provides promising evidence, several gaps remain. Much of the research on EI-focused professional development relies on single-case designs with small samples and limited contextual diversity. Group experimental studies are fewer and have been conducted primarily in the United States (e.g., P. Snyder et al., 2018; P. A. Snyder et al., 2026). Additional experimental research is needed to examine the effectiveness of EI-focused professional development across diverse educational contexts. The present study extends this research by examining the effects of the Supporting Early Education through Embedded Instruction (SEED-EI) professional development model, previously piloted using a single-case design (Rakap et al., 2024), on preschool teachers' implementation of EI practices and children's learning outcomes in inclusive preschool classrooms in Türkiye using a randomized controlled design. The study also explored teachers' perceptions of the professional development program and the feasibility of implementing EI practices. The following research questions guided the study: (1) Do preschool teachers' implementation of embedded instruction differ across conditions? (2) Do children's learning outcomes differ across conditions? (3) What are teachers' perceptions of the SEED-EI professional development program and EI practices?

2. Method

2.1. Study Design

We conducted a three-group randomized controlled trial over one school year with 36 preschool teachers recruited from preschool programs affiliated with the Turkish Ministry of National Education in Samsun and surrounding districts in Türkiye. Institutional ethical approval for the study was obtained prior to recruitment. Written informed consent was obtained from all participating teachers and from parents of participating children. The unit of random assignment was the teacher. After informed consent was obtained, teachers were assigned to one of three conditions through a simple random assignment procedure.

Specifically, teachers were assigned identification numbers, and a computer-generated randomization procedure (using a random number generator) was used to allocate teachers to one of the three experimental conditions. Each experimental condition included 12 teachers. Subsequent to teachers' enrollment but prior to their random assignment to conditions, one child with disabilities from each teacher's classroom was recruited for participation. Teachers nominated children who met the study's eligibility criteria. In total, 36 children with disabilities participated in the study. These children were referred to as target children for the purposes of the study.

2.2. Participants and Settings

2.2.1. Teachers

Participants included 36 preschool teachers employed in inclusive preschool classrooms affiliated with the Ministry of National Education in Samsun, Türkiye. Teachers were eligible to participate if they (a) held a bachelor's degree in early childhood education, (b) had at least two years of teaching experience, and (c) had at least one child with disabilities enrolled in their classroom. The requirement for a minimum of two years of experience was established to minimize the influence of the induction period experienced by novice teachers. Teachers were excluded from participation if they did not meet these criteria, including those with less than two years of teaching experience, those without a child with disabilities in their classroom, or those without the required educational qualifications. Two months before the beginning of the study, a list of preschool teachers meeting these criteria was obtained from the provincial education authority. From this list, 100 teachers were randomly selected and invited to participate in the study. Fifty teachers returned signed informed consent forms, and 36 teachers were randomly selected from this pool to participate in the experimental study. The remaining 14 teachers were placed on a waitlist.

Teachers in all experimental conditions were employed under the same local education authority, and therefore, the professional development opportunities required and available during the school year were comparable across teachers. These professional development activities were provided through the Ministry of National Education and were unrelated to the study. Importantly, none of the professional development activities offered during the study period (i.e., the academic year in which the study was conducted) focused on EI practices or PBC. The SEED-EI professional development activities implemented in this study were therefore additional to, and distinct from, the professional learning opportunities normally available to teachers.

2.2.2. Classrooms

Participating classrooms were inclusive preschool classrooms serving both typically developing children and children with disabilities within the public preschool system operated by the Ministry of National Education. Classrooms followed typical preschool daily schedules that included free play, circle time, small-group instruction, center activities, routines, and transitions. These activities provided multiple opportunities for teachers to implement EI trials targeting individualized learning goals for children with disabilities. As shown in Table 1, the demographic characteristics of teachers and classrooms were comparable across experimental conditions. Statistical analyses indicated no significant differences across the three groups on any teacher or classroom variables, suggesting that the groups were comparable at baseline.

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

Variable	BAU Control (n = 12)	SEED-EI Workshop (n = 12)	SEED-EI Coaching (n = 12)	χ^2	F	p
Gender						
Female	11 (92)	12 (100)	11 (92)	1.06	-	0.59
Male	1 (8)	0	1 (8)			
Highest education						
Bachelor	10 (83)	10 (83)	11 (92)	0.47	-	0.79
Master	2 (17)	2 (17)	1 (8)			
Mean age in years (SD)	35.42 (6.75)	36.67 (5.47)	33.92 (5.44)	-	0.64	0.54
Teaching experience in years (SD)	13.17 (6.59)	14.25 (5.93)	11.25 (5.63)	-	0.75	0.48
Experience with children with disabilities in years (SD)	6.83 (3.22)	7.50 (3.15)	6.42 (2.91)	-	0.38	0.69
Mean number of children in classroom (SD)	17 (3.49)	15.17 (3.71)	16.58 (3.12)	-	0.93	0.40
Mean number of children with disabilities (SD)	1.33 (0.49)	1.50 (0.52)	1.42 (0.52)	-	0.32	0.73

Note. BAU = business-as-usual; SEED-EI = Supporting Early Education and Development—Embedded Instruction; SD = Standard deviation. Values are presented as frequencies (n) and percentages (%) for categorical variables.

2.2.3. Target Children

A total of 36 children with disabilities participated in the study, with one child selected from each participating teacher's classroom. Children were eligible for participation if they were between 36 and 72 months of age, had an identified disability, and had an IEP. Disability classifications were based on official school records and diagnoses documented in children's IEPs, which are determined through a comprehensive assessment and placement system in Türkiye. The reported disability categories reflect the primary diagnosis for each child; no comorbid diagnoses were reported in school records for the participating children. In the Turkish education system, children with more severe disabilities are typically educated in specialized settings; therefore, children included in inclusive preschool classrooms generally present with mild to moderate support needs. Teachers nominated children who met these criteria, and written parental consent was obtained prior to participation. As shown in Table 2, the demographic characteristics of participating children were comparable across experimental conditions. No statistically significant differences were found across groups for any of the measured child variables.

Table 2. Comparisons of Child Characteristics by Experimental Condition.

Variable	BAU Control (n = 12)	SEED-EI Workshop (n = 12)	SEED-EI Coaching (n = 12)	χ^2	F	p
Gender						
Female	4 (33)	7 (58)	4 (33)	2.06	-	0.36
Male	8 (67)	5 (42)	8 (67)			
Mean age in months (SD)	50.75 (7.72)	55.17 (8.31)	55 (6.25)	-	1.34	0.28
Disability category, %						
Intellectual disability	66.7	50	41.7	2.04	-	0.66
Autism spectrum disorder	16.7	16.7	33.3			
Speech and language disorder	16.7	33.3	25			

Note. BAU = business-as-usual; SEED-EI = Supporting Early Education and Development—Embedded Instruction; SD = Standard deviation. Values are presented as frequencies (n) and percentages (%) for categorical variables.

2.3. Experimental Conditions

The professional development intervention was designed to support preschool teachers' implementation of EI practices in inclusive preschool classrooms and was referred to as SEED-EI (Supporting Early Education and Development—Embedded Instruction). Two variants of the SEED-EI PD intervention were examined in the present study. Both variants included professional development workshops and instructional materials designed to support teachers' use of EI practices, whereas one condition also included PBC to support teachers' implementation of the practices in their classrooms. Teachers were assigned to one of three experimental conditions: (a) BAU instruction (control), (b) SEED-EI workshops, or (c) SEED-EI workshops combined with PBC (hereafter referred to as SEED-EI coaching). Teachers in each group identified three instructional targets for the participating child in their classroom: one in the social domain (including language and communication), one in the cognitive domain, and one in the self-care or motor domain. Teachers reported these targets using the Target Behavior Request Form.

2.3.1. BAU Control Condition

Teachers assigned to the control condition continued to provide instruction in their classrooms as they typically would during the school year and did not receive training related to EI during the study period. Teachers in the control group, as well as those who were waitlisted, were offered abbreviated versions of the SEED-EI workshops after the completion of the study.

2.3.2. SEED-EI Workshop Condition

Teachers assigned to the workshop condition participated in four professional development workshops totaling approximately 14 h. All workshops were delivered face-to-face in small group settings. Workshops were delivered at three-week intervals and were organized into four modules reflecting the core components of EI. The first training session, which lasted 2.5 h, focused on an overview of EI. During this session, teachers were introduced to the key concepts and principles underlying EI and how these practices can be used to support the learning of children with disabilities within inclusive preschool classrooms. The second training session, which lasted 4 h, focused on planning EI. This session emphasized helping teachers learn how to identify individualized instructional objectives and plan opportunities for EI trials to occur during ongoing classroom activities, routines, and transitions. The third training session, which lasted 3.5 h, focused on implementing EI. During this session, teachers learned instructional strategies for embedding teaching opportunities within naturally occurring classroom contexts and practiced applying these strategies to classroom activities and routines. The fourth training session, which lasted 4 h, focused on evaluating EI and child learning outcomes. This session emphasized strategies for monitoring teachers' implementation of EI and evaluating children's progress toward instructional objectives. Teachers also learned how to use data-based decision-making processes to adjust and improve their instructional practices.

Teachers received workshop guides and implementation guides that summarized the key concepts and procedures addressed in each module and provided practical supports for classroom implementation. These materials included examples of instructional targets, planning templates, and guidance for integrating instructional trials into daily classroom routines. Between workshop sessions, teachers completed practice activities designed to support the application of workshop content in their classrooms. During subsequent workshop sessions, teachers discussed their experiences implementing EI strategies, shared challenges they encountered, and received feedback and suggestions from the trainer and other participating teachers. Following the workshops, teachers were instructed to teach the

identified target skills to the participating children using embedded instruction strategies learned during the workshop training.

The training sessions were developed based on the three major components of effective teaching: planning, instruction, and assessment. The scope and sequence of the content and the format of the training sessions were informed by a comprehensive review of the empirical literature on naturalistic instruction for young children and existing materials related to EI practices (e.g., Amsbary & AFIRM Team, 2017; Early Childhood Personnel Center, 2018; Early Childhood Technical Assistance Center, 2017; Grisham-Brown et al., 2005; Horn & Banerjee, 2009; Noonan & McCormick, 2014; Rule et al., 1998; Sandall et al., 2019; P. A. Snyder et al., 2015b; The Center to Mobilize Early Childhood Knowledge, 2018; Thompson, 2011). The content and structure of the training were also refined and informed by findings from a pilot implementation of the training program conducted prior to the present study (Rakap et al., 2024).

2.4. SEED-EI Workshops Plus Practice-Based Coaching

Teachers assigned to the workshops-plus-coaching condition participated in the same workshop training described above and were instructed to teach the identified target skills to participating children using embedded instruction strategies learned during the training. In addition, they received practice-based coaching (PBC) to support the implementation of EI strategies. Coaching began the week following the first workshop session and continued for 16 weeks. Sessions occurred once per week and lasted approximately 2.5 h, including about two hours of classroom observation followed by a 30 min feedback meeting. During observations, coaches documented teachers' instructional practices during classroom routines, activities, and transitions using the Practice-Based Coaching Guide, with a focus on teachers' efforts to embed instructional opportunities for the target child within ongoing classroom activities.

Following the observation period, coaches met with teachers to discuss the observation, provide supportive and constructive feedback, answer teachers' questions, and assist teachers in planning future instructional opportunities. During these meetings, teachers and coaches discussed ways to increase the frequency and quality of EI trials and to refine the implementation of instructional strategies. Across the study, a total of 192 coaching sessions were conducted (12 teachers $\times$ 16 sessions). Observation sessions lasted an average of 121 min (range = 114–130 min), and feedback meetings averaged 31 min (range = 26–35 min).

Four members of the research team served as coaches. The coaches included three females and one male, ranging in age from 28 to 39 years. Two coaches were doctoral students, one held a master's degree, and one was a master's student. All coaches had professional experience in early childhood education or special education, with years of experience ranging from 3 to 17 years. In addition, all four coaches had prior experience providing PBC, which they gained during the pilot investigation of the intervention (Rakap et al., 2024). These individuals attended the workshop sessions with participating teachers and received training from the principal investigator on coaching procedures, including the use of coaching observation guides, procedures for conducting classroom observations, strategies for providing effective feedback, and methods for supporting teachers in planning EI opportunities.

2.5. Implementation Fidelity

Implementation fidelity data were collected to determine the extent to which the workshops and PBC sessions were implemented as planned. Fidelity was assessed using two project-developed instruments: the Workshop Implementation Fidelity Form and the

Practice-Based Coaching Implementation Fidelity Form. Observations were conducted during all workshop sessions and a randomly selected sample of coaching sessions by an independent observer not involved in intervention delivery. For the workshop component, fidelity data were collected during all four sessions delivered to each experimental group. The observer used the Workshop Implementation Fidelity Form to assess whether content and activities were implemented as planned. Results indicated 100% fidelity across all workshop sessions in both experimental groups, suggesting consistent implementation of training procedures. For the PBC component, fidelity data were collected for 31% of coaching sessions (n = 60). Fidelity observations were distributed across all four coaches to ensure that coaching practices were monitored consistently across implementers. The observer used the Practice-Based Coaching Implementation Fidelity Form to document adherence to the coaching protocol during observations and feedback meetings. Results indicated high fidelity, with an average score of 97% (range = 93–100), suggesting that coaches closely followed established procedures. The proportion of observed sessions (31%) exceeds commonly recommended standards for treatment fidelity assessment, which typically suggest sampling at least 20–25% of sessions across participants and implementers (e.g., Horner et al., 2005; Ledford & Gast, 2018). Fidelity for both workshops and coaching sessions was calculated using the formula: (Number of correctly implemented trainer or coach behaviors ÷ Number of expected behaviors) × 100.

2.6. Dependent Measures

Teacher- and child-level dependent measures were examined in this study. Data for these measures were obtained through systematic observation of teacher–child interactions during naturally occurring classroom activities. All observational data were collected by trained project personnel who were not involved in delivering the intervention. Data were gathered at three time points: prior to the intervention (pretest), after completion of the professional development workshops, and following completion of the PBC (posttest). Observations focused on instructional interactions targeting the three individualized skills identified for each child, as described above. The procedures and measures used to evaluate teacher implementation and child responses are described below.

Teacher Implementation Measure. Teachers' implementation of EI trials was measured using the Embedded Teaching Coding Form (ETCF; Rakap & Balikci, 2017). This observational coding system was used to analyze video recordings of teacher–child instructional interactions during regular classroom activities. The ETCF allows observers to document both complete and incomplete ELOs implemented by teachers as well as children's responses to instructional attempts. An EI trial was considered complete when the teacher implemented all essential instructional components. Specifically, the teacher first delivered an antecedent (e.g., task request or instructional direction) and then provided an appropriate consequence based on the child's response. Consequences included verbal praise or access to materials following correct responses or the implementation of an error correction procedure when the child's response was incorrect or absent. An EI trial was coded as incomplete when the teacher presented an antecedent but did not allow sufficient response time or failed to provide an appropriate consequence or error correction following the child's response. Teacher performance was calculated by determining the rate (per minute), frequency and percentage of EI trials implemented correctly during each observation session. This measure served as the primary dependent variable for evaluating teachers' use of EI opportunities across study phases.

Child Outcome Measure. Children's responses during instructional interactions were also coded using the ETCF. Four types of child responses were recorded: unprompted correct response, prompted correct response, incorrect response, and no response. An

unprompted correct response was coded when the child independently performed the target behavior within three seconds of the teacher's antecedent. A prompted correct response was coded when the child performed the target behavior correctly following a prompt delivered after the antecedent. An incorrect response was coded when the child engaged in a behavior other than the target behavior following the teacher's antecedent (and prompt). A no-response code was used when the child did not demonstrate any behavior following the antecedent (and prompt). For each data collection session, the rate (per minute), frequency and percentage of unprompted correct child responses were calculated. These data were used to examine changes in children's performance associated with teachers' implementation of ELOs.

Social Validity Measure. Social validity data were collected to examine teachers' perceptions of the acceptability, usefulness, and feasibility of the SEED-EI professional development intervention and EI practices. Three instruments were used. First, teachers in both intervention conditions (n = 24) completed a 10-item workshop evaluation form assessing their perceptions of the SEED-EI workshops. Items were rated on a 4-point Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree). Second, teachers in the SEED-EI coaching condition (n = 12) completed a 25-item coaching questionnaire designed to assess their perceptions of the practice-based coaching (PBC) process. Items were rated on a 6-point Likert-type scale ranging from 1 (strongly disagree) to 6 (strongly agree). Third, teachers in both intervention conditions (n = 24) completed a sustainability questionnaire to evaluate their perceptions of EI as an instructional practice. Items were rated on a 6-point Likert-type scale ranging from 1 (strongly disagree) to 6 (strongly agree). All questionnaires were administered following the completion of the intervention. Responses were summarized using descriptive statistical procedures (e.g., means, standard deviations, and ranges) to describe teachers' overall perceptions.

2.7. Data Collection and Analysis Procedures

Data related to the dependent variables were collected at two time points across the study: prior to the implementation of the intervention (pretest) and after completion of the classroom-based practice coaching phase (posttest). During each data collection period, trained project personnel visited participating classrooms according to teachers' daily schedules and video recorded interactions between the teacher and the participating child using tablet computers. Recording began at the start of classroom instruction and continued throughout the school day during periods when the teacher interacted with the participating child. Video recording was paused when the teacher interacted with other children in the classroom. The recorded videos were transferred to a secure digital environment and prepared for observational coding. Graduate research assistants trained by the research team reviewed the video recordings and coded teacher–child interactions using the ETCF. For each observation session, the number of correctly implemented EI trials, the percentage of correct trials, and the rate of correct trials (number of correct trials per minute) were calculated. In addition, child performance was evaluated by calculating the number, percentage, and rate of correct child responses to instructional opportunities.

To examine baseline equivalence across experimental conditions, chi-square analyses were conducted for categorical variables (e.g., gender, disability category), and one-way analyses of variance (ANOVA) were conducted for continuous variables (e.g., age, teaching experience). These analyses were used to determine whether groups differed significantly on pretest characteristics prior to the intervention.

To examine the relationship between the professional development intervention and teachers' use of EI (Research Question 1) and children's performance on learning targets (Research Question 2), mixed-design analysis of variance (mixed ANOVA; Maxwell &

Delaney, 1990) was conducted. In the present study, the between-subjects factor consisted of three groups (BAU Control Group, SEED-EI workshop, and SEED-EI coaching), and the dependent variables (teachers' implementation of EI and children's correct response levels) were measured at two time points (pretest and posttest). The mixed ANOVA addressed three primary questions: (1) whether there were overall differences between the groups, (2) whether the mean scores differed across the two measurement occasions, and (3) whether there was a statistically significant interaction between group membership and measurement occasion. Mixed-design ANOVA with two time points relies on several statistical assumptions, including normality and homogeneity of variances. Prior to analysis, data were screened to ensure that these assumptions were reasonably met. In addition, previous research indicates that ANOVA procedures are robust to moderate violations of normality and homogeneity when group sizes are equal (Myers et al., 2013). Because the number of participants in each group was equal in the present study, the analytic approach was considered appropriate and robust. Teachers' perceptions of the professional development intervention and their views regarding EI practices (Research Question 3) were examined using data obtained from two questionnaires. Quantitative survey data were analyzed using descriptive statistical procedures (e.g., means, standard deviations, frequencies, and ranges).

2.8. Interobserver Agreement

To evaluate the reliability of observational coding using ETCF, a second observer independently coded approximately 30% of observation sessions. Interobserver agreement was calculated using the formula: [agreements ÷ (agreements + disagreements)] × 100. Interobserver agreement levels were high across all groups and measurement occasions. For the BAU control group, mean agreement coefficients were 95.75% (SD = 3.78) at pretest and 95.50% (SD = 4.44) at posttest. For the SEED-EI workshop group, mean agreement values were 92.75% (SD = 1.71) at pretest and 95.25% (SD = 4.27) at posttest. For the SEED-EI coaching group, agreement levels were 95.75% (SD = 2.75) at pretest and 94.00% (SD = 5.23) at posttest. Overall, interobserver agreement coefficients ranged from 92.50% to 95.75%, indicating a high level of reliability in the observational coding procedures.

3. Results

3.1. Teacher Outcomes

Teachers' implementation of EI was evaluated using three indicators: (a) frequency of correct EI trials, (b) rate of correct EI trials, and (c) percentage of correctly implemented EI trials. Descriptive statistics are presented in Table 3.

Frequency of Correct EI Trials. The mixed ANOVA revealed a significant main effect of measurement occasion, $F(1,33) = 222.9$, $p < 0.001$, $\eta^2G = 0.813$, and a significant main effect of group, $F(2,33) = 122.0$, $p < 0.001$, $\eta^2G = 0.725$. The group × measurement interaction was also significant, $F(2,33) = 70.5$, $p < 0.001$, $\eta^2G = 0.733$, indicating that changes in implementation frequency differed across groups. Post hoc comparisons showed no significant change for teachers in the BAU control condition (Mdiff = 0.08, $p = 1.00$). Teachers in the SEED-EI workshops condition demonstrated significant increases from pretest to posttest (Mdiff = 3.75, $p < 0.001$), and teachers in the SEED-EI coaching condition showed larger increases (Mdiff = 7.33, $p < 0.001$). At posttest, both intervention groups significantly outperformed the BAU group (Mdiff = 3.75 for workshops; Mdiff = 7.17 for coaching; both $p < 0.001$). Teachers receiving coaching also demonstrated significantly higher implementation frequencies than those in the workshops condition (Mdiff = 3.42, $p < 0.001$).

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

Variable—Wave	SEED-EI Coaching			SEED-EI Workshop			BAU Control		
	N	M	SD	N	M	SD	N	M	SD
Teacher-Frequency									
Pretest	12	0.25	0.45	12	0.42	0.52	12	0.33	0.49
Posttest	12	7.58	1.68	12	4.17	1.19	12	0.42	0.52
Teacher-Rate									
Pretest	12	0.03	0.07	12	0.04	0.05	12	0.03	0.05
Posttest	12	0.68	0.24	12	0.42	0.16	12	0.04	0.05
Teacher-Percentage									
Pretest	12	10.4	19.8	12	12.5	15.7	12	9.3	14.2
Posttest	12	91.5	8.67	12	48.4	15.3	12	16	20.9
Child-Frequency									
Pretest	12	0.08	0.29	12	0.08	0.29	12	0.17	0.39
Posttest	12	7.42	1.68	12	3.67	0.78	12	0.33	0.49
Child-Rate									
Pretest	12	0.01	0.02	12	0.01	0.03	12	0.02	0.03
Posttest	12	0.67	0.23	12	0.37	0.12	12	0.04	0.05
Chil-Percentage									
Pretest	12	4.17	14.4	12	2.08	7.22	12	4.86	11.5
Posttest	12	89.8	12.2	12	42.7	10	12	13.2	20.6

Note. SEED-EI = Supporting Early Education through Embedded Instruction; Business-As-Usual = BAU.

Rate of Correct EI Trials. The mixed ANOVA revealed a significant main effect of measurement occasion, $F(1,33) = 122.4$, $p < 0.001$, $\eta^2G = 0.682$, and a significant main effect of group, $F(2,33) = 49.2$, $p < 0.001$, $\eta^2G = 0.557$. The interaction between group and measurement occasion was significant, $F(2,33) = 35.6$, $p < 0.001$, $\eta^2G = 0.555$. Teachers in the BAU group did not demonstrate significant changes across measurement occasions (Mdiff = 0.01, $p = 1.00$). In contrast, teachers in the workshops condition increased significantly (Mdiff = 0.388, $p < 0.001$), as did teachers in the coaching condition (Mdiff = 0.623, $p < 0.001$). Posttest comparisons indicated that both intervention groups demonstrated higher rates of correct EI trials than the BAU group (Mdiff = 0.39 for workshops; Mdiff = 0.65 for coaching; both $p < 0.001$). The coaching group also showed significantly higher rates than the workshop group (Mdiff = 0.26, $p = 0.01$).

Percentage of Correct EI Trials. The mixed ANOVA revealed a significant main effect of measurement occasion, $F(1,33) = 99.2$, $p < 0.001$, $\eta^2G = 0.637$, and a significant main effect of group, $F(2,33) = 40.2$, $p < 0.001$, $\eta^2G = 0.503$. The interaction effect was also significant, $F(2,33) = 27.4$, $p < 0.001$, $\eta^2G = 0.492$. Teachers in the BAU condition did not demonstrate significant changes across measurement occasions (Mdiff = 6.67, $p = 1.00$). Teachers in the workshops condition showed significant increases in implementation accuracy from pretest to posttest (Mdiff = 35.86, $p < 0.001$), and teachers in the coaching condition demonstrated even larger increases (Mdiff = 81.07, $p < 0.001$). Posttest comparisons indicated that both intervention groups significantly outperformed the BAU group (Mdiff = 32.38 for workshops; Mdiff = 75.52 for coaching; both $p \leq 0.01$). Teachers in the coaching condition also demonstrated significantly higher implementation accuracy than those in the workshops condition (Mdiff = 43.14, $p < 0.001$).

3.2. Child Outcomes

Children's learning outcomes were evaluated using three indicators: (a) frequency of correct responses, (b) rate of correct responses, and (c) percentage of correct responses. Descriptive statistics are presented in Table 3.

Frequency of Correct Child Responses. The mixed ANOVA revealed a significant main effect of measurement occasion, $F(1,33) = 343.0$, $p < 0.001$, $\eta^2G = 0.849$, and a significant main effect of group, $F(2,33) = 121.0$, $p < 0.001$, $\eta^2G = 0.771$. The group × measurement interaction was also significant, $F(2,33) = 108.0$, $p < 0.001$, $\eta^2G = 0.779$. Children in the control group did not demonstrate significant changes across measurement occasions (Mdiff = 0.17, $p = 1.00$). In contrast, children in the workshops condition showed significant increases from pretest to posttest (Mdiff = 3.58, $p < 0.001$), and children in the coaching condition demonstrated larger increases (Mdiff = 7.33, $p < 0.001$). Posttest comparisons indicated that both intervention groups significantly outperformed the control group (Mdiff = 3.33 for workshops; Mdiff = 7.08 for coaching; both $p < 0.001$). Children in the coaching condition also demonstrated significantly higher frequencies of correct responding than those in the workshops condition (Mdiff = 3.75, $p < 0.001$).

Rate of Correct Child Responses. The mixed ANOVA revealed a significant main effect of measurement occasion, $F(1,33) = 173.0$, $p < 0.001$, $\eta^2G = 0.734$, and a significant main effect of group, $F(2,33) = 52.4$, $p < 0.001$, $\eta^2G = 0.601$. The interaction between group and measurement occasion was significant, $F(2,33) = 49.7$, $p < 0.001$, $\eta^2G = 0.613$. Children in the control group did not demonstrate significant changes across measurement occasions (Mdiff = 0.02, $p = 0.998$). In contrast, children in the workshops condition demonstrated significant increases (Mdiff = 0.362, $p < 0.001$), and children in the coaching condition showed larger increases (Mdiff = 0.668, $p < 0.001$). Posttest comparisons indicated that children in both intervention groups demonstrated significantly higher response rates than those in the control group (Mdiff = 0.34 for workshops; Mdiff = 0.64 for coaching; both $p < 0.001$). The coaching group also demonstrated significantly higher response rates than the workshop group (Mdiff = 0.30, $p < 0.001$).

Percentage of Correct Child Responses. The mixed ANOVA revealed a significant main effect of measurement occasion, $F(1,33) = 196.0$, $p < 0.001$, $\eta^2G = 0.756$, and a significant main effect of group, $F(2,33) = 52.3$, $p < 0.001$, $\eta^2G = 0.603$. The interaction between group and measurement occasion was also significant, $F(2,33) = 49.0$, $p < 0.001$, $\eta^2G = 0.607$. Children in the control group did not demonstrate significant changes across measurement occasions (Mdiff = 8.34, $p = 1.00$). Children in the workshops condition showed significant increases in response accuracy (Mdiff = 40.61, $p < 0.001$), and children in the coaching condition demonstrated even larger increases (Mdiff = 85.65, $p < 0.001$). Posttest comparisons indicated that both intervention groups significantly outperformed the control group (Mdiff = 29.50 for workshops; Mdiff = 76.62 for coaching; both $p < 0.001$). Children in the coaching condition also demonstrated significantly higher response accuracy than those in the workshops condition (Mdiff = 47.13, $p < 0.001$).

3.3. Social Validity

Social Validity of SEED-EI Workshop. Teachers in both intervention conditions ($n = 24$) evaluated the SEED-EI workshops using a 10-item evaluation form rated on a 4-point scale (1 = strongly disagree to 4 = strongly agree). Overall perceptions were positive, with mean ratings of 3.54 in the SEED-EI workshops condition and 3.73 in the SEED-EI coaching condition. Teachers agreed that the workshops were well organized, that the learning objectives were clear and achieved (Ms ≈ 3.50–3.75), and that the content was useful and applicable to their work with young children with disabilities (M = 3.75 in both groups). Teachers also reported that they would recommend the workshops to other preschool teachers (M = 3.50 for workshops; M = 3.75 for coaching). Although most items were rated similarly across groups, several items were rated slightly higher by teachers in the coaching condition, suggesting somewhat more favorable perceptions among teachers who received additional PBC.

Social Validity of SEED-EI Coaching. Teachers in the SEED-EI coaching condition (n = 12) reported high levels of satisfaction with the coaching process on a 25-item questionnaire rated on a 6-point scale. Overall ratings were high (M = 5.66), with 23 of the 25 items receiving mean ratings above 5.5. Teachers reported particularly strong agreement that coaching helped them identify strengths and areas for improvement (M = 5.92), that sessions occurred frequently enough (M = 5.83), and that they developed a positive working relationship with the coach (M = 5.92). Teachers also indicated intentions to continue implementing EI following the coaching process (M = 5.92). Overall, these findings suggest that teachers perceived the coaching process as highly acceptable and supportive of EI implementation.

Social Validity of EI. Teachers in both intervention conditions (n = 24) also completed a sustainability questionnaire assessing their perceptions of EI as an instructional practice. Overall ratings were positive, with mean scores of 5.21 for teachers in the workshops condition and 5.72 for teachers in the coaching condition (6-point scale). Teachers agreed that EI effectively supported children's learning, was appropriate for teaching a variety of skills, and was compatible with typical classroom practices. They also indicated that EI could be implemented within daily preschool routines without disrupting classroom flow. Across items, teachers in the coaching condition reported higher ratings than those in the workshops condition, suggesting stronger perceptions of EI's acceptability and greater intentions to continue using the practice.

4. Discussion

The present study examined the effects of two professional development (PD) approaches, SEED-EI workshops and SEED-EI workshops combined with practice-based coaching, on preschool teachers' implementation of embedded instruction (EI) and the learning outcomes of children with disabilities in inclusive preschool classrooms. Results indicated that both PD interventions improved teachers' use of EI relative to business-as-usual professional development. Teachers who participated in the SEED-EI workshops demonstrated significant increases in the frequency, rate, and accuracy of EI trials following the training sessions, whereas teachers in the BAU condition did not demonstrate meaningful changes across measurement occasions. Teachers who received SEED-EI coaching demonstrated the greatest improvements in EI implementation, including continued gains between the post-workshop and posttest measurements. These findings suggest that structured workshop training can support teachers' acquisition of EI practices, but additional job-embedded coaching support may be necessary to promote higher levels of implementation and sustained use of EI in classroom contexts.

These findings are consistent with previous research indicating that professional development models combining training with ongoing coaching tend to be more effective for improving teachers' implementation of evidence-based practices than training alone (Darling-Hammond et al., 2017; Sims et al., 2021; P. Snyder et al., 2018; P. A. Snyder et al., 2026). Coaching allows teachers to apply newly learned practices within authentic classroom environments while receiving individualized feedback and guidance, which may facilitate the translation of knowledge into practice (Artman-Meeker et al., 2022; Hemmeter et al., 2016; Kraft et al., 2018; Rakap et al., 2025). In the present study, teachers who received coaching demonstrated not only greater increases in the frequency of EI trials but also higher levels of implementation accuracy compared with teachers who participated in workshops only. These findings align with implementation science frameworks suggesting that competency-based supports, such as coaching and performance feedback, play an essential role in supporting practitioners' adoption and sustained use of evidence-based instructional practices (Dunst et al., 2013; Fixsen et al., 2019; Metz & Bartley, 2012).

The pattern of findings observed in this study is also consistent with previous research indicating that EI practices are often implemented infrequently or inconsistently in early childhood classrooms without targeted professional development and job-embedded support (Rahn et al., 2019; Rakap et al., 2024; P. Snyder et al., 2018; P. A. Snyder et al., 2026). EI requires teachers to identify appropriate learning targets, plan instructional opportunities within naturally occurring activities, and deliver systematic instructional interactions while maintaining the flow of classroom routines. These instructional demands may make EI difficult to implement consistently without ongoing support. Coaching may therefore serve as a critical mechanism for helping teachers integrate EI strategies into everyday classroom activities, refine their instructional decisions, and increase both the frequency and accuracy of ELOs.

Findings from the present study also demonstrated positive effects of the PD interventions on children's learning outcomes. Children whose teachers participated in either the SEED-EI intervention condition demonstrated significantly higher frequencies, rates, and percentages of correct responses than children whose teachers were in the BAU control condition. These findings are consistent with previous research documenting the effectiveness of EI for promoting developmental and learning outcomes among young children with disabilities (Gulboy et al., 2023; Rakap & Parlak-Rakap, 2011; P. A. Snyder et al., 2015b, 2026; P. Snyder et al., 2018). Importantly, the largest gains in child performance were observed in classrooms where teachers received workshops combined with coaching. This pattern of findings provides further evidence supporting the hypothesized link between teachers' implementation of evidence-based instructional practices and children's learning outcomes (Cook et al., 2019; Nelson et al., 2022; Odom, 2009).

The relationship between teacher implementation and child outcomes observed in the present study suggests that improvements in teachers' use of EI likely increased the number and quality of learning opportunities available to children during everyday classroom activities. When teachers implemented EI trials more frequently and accurately, children were provided with more opportunities to practice target skills within meaningful contexts embedded in ongoing classroom routines. Naturalistic instructional approaches such as EI are designed to capitalize on children's interests and ongoing activities, which may increase children's engagement and responsiveness during instructional interactions. Thus, increases in teachers' implementation of EI may have contributed directly to the improvements observed in children's performance on targeted learning outcomes (P. A. Snyder et al., 2026).

The social validity findings further support the feasibility and acceptability of the SEED-EI professional development model. Teachers in both intervention conditions reported positive perceptions of the workshops and indicated that the training content was useful and applicable to their classroom practice. Teachers who received coaching reported particularly high levels of satisfaction with the coaching process and emphasized the value of individualized feedback and collaborative problem solving for supporting instructional implementation. In addition, teachers reported favorable perceptions of EI as an instructional approach, indicating that the practice was feasible to implement within typical preschool routines and beneficial for supporting children's learning. These findings are consistent with previous studies demonstrating high levels of practitioner acceptance for coaching-supported PD models and naturalistic instructional practices in early childhood education (Early et al., 2017; Hemmeter et al., 2016; P. Snyder et al., 2018; P. A. Snyder et al., 2026; Yang et al., 2022).

Overall, the findings of the present study contribute to a growing body of literature examining professional development approaches designed to support teachers' implementation of EI in inclusive early childhood settings (P. Snyder et al., 2018; P. A. Snyder

et al., 2026). By employing a randomized controlled design and examining both teacher implementation and child outcomes, the study provides additional empirical support for PD models that combine workshops with job-embedded coaching supports. Importantly, this study extends previous work conducted primarily in North American contexts by demonstrating the effectiveness of such approaches within the Turkish early childhood education system. The findings therefore provide additional evidence regarding the potential generalizability of EI-focused professional development interventions across diverse educational and cultural contexts.

4.1. Limitations

Several limitations of the present study should be considered when interpreting the findings. First, the sample size was relatively small, including 36 teachers and 36 children, which may limit the generalizability of the findings; therefore, replication with larger samples across multiple regions and diverse educational contexts would strengthen confidence in the observed effects and help establish the robustness and generalizability of the intervention. Second, teachers volunteered to participate in the study and may have been more motivated to implement new instructional practices than the broader population of preschool teachers. As a result, the findings may not fully represent implementation outcomes among teachers who are less motivated or have fewer supports available.

Third, although teachers were randomly assigned to experimental conditions, child outcomes were nested within teachers. The relatively small sample size prevented the use of hierarchical statistical analyses to account for the nested structure of the data and examine potential classroom-level influences on teachers' responsiveness to the professional development intervention. In addition, although disability categories were based on official records and reflected primary diagnoses, the study did not include direct measures of disability severity. Although children in inclusive preschool classrooms in Türkiye typically present with mild to moderate support needs, unmeasured differences in individual child characteristics (e.g., severity of disability or learning profiles) may have influenced both teacher implementation and child outcomes. Future research should include more detailed assessments of child characteristics to better examine their potential moderating effects.

Fourth, the study relied primarily on observational measures of teacher implementation and child responses during classroom interactions. Although these measures are well aligned with EI practices, additional outcome measures, such as standardized developmental assessments or longer-term follow-up measures, could provide further evidence regarding the broader impacts of the intervention on children's development. Finally, the intervention was implemented under controlled conditions with support from trained project staff and coaches. Implementation fidelity was high for both workshops and coaching sessions; however, additional research is needed to determine whether similar levels of fidelity and effectiveness can be achieved when the intervention is implemented at scale within typical educational systems.

4.2. Implications for Research

The findings of the present study suggest several directions for future research. First, additional large-scale randomized trials are needed to further examine the effectiveness of professional development models designed to support teachers' implementation of EI. Larger samples would enable researchers to investigate potential mediating and moderating factors influencing teacher implementation and child outcomes, such as teacher experience, classroom characteristics, or coaching intensity. Future studies should also examine the extent to which intervention effects vary across educational systems, program types, and

practitioner characteristics, thereby extending the evidence base for EI-focused professional development across diverse contexts.

Second, future studies should examine the optimal dosage and structure of coaching supports needed to sustain teachers' use of EI practices over time. Research suggests that the format and intensity of coaching may influence teacher implementation outcomes, highlighting the need to compare different coaching dosages and delivery formats, including combinations of in-person and remote coaching. Research comparing different coaching models, such as on-site coaching, virtual coaching, peer coaching, or artificial intelligence-supported self-coaching, may provide important insights into how professional development can be delivered efficiently while maintaining effectiveness.

Third, longitudinal studies examining longer-term child outcomes would help determine whether improvements in EI implementation lead to sustained gains in children's developmental trajectories. Follow-up studies examining the maintenance and generalization of teachers' EI implementation over time may also provide important insights into the sustainability of professional development interventions. Finally, future research could explore the scalability and cost-effectiveness of professional development models such as SEED-EI within broader early childhood education systems. Implementation research examining how such interventions can be integrated into existing teacher professional learning infrastructures would provide valuable guidance for policymakers and program administrators.

4.3. Implications for Practice

The findings of this study have several practical implications for early childhood educators, program administrators, and policymakers. First, the results suggest that workshop-only training may not be sufficient to ensure high-fidelity implementation of EI practices. Professional development models that combine workshops with ongoing coaching support may be more effective for promoting meaningful changes in instructional practice. Consistent with previous research, job-embedded coaching may function as a critical component of professional development interventions designed to enhance teachers' implementation of EI practices.

Second, coaching appears to play an important role in helping teachers integrate EI strategies into daily classroom routines and activities. By providing individualized feedback and collaborative problem-solving opportunities, coaching can support teachers in translating newly acquired knowledge into effective instructional practice. Early childhood programs seeking to improve inclusive instructional practices may therefore consider incorporating coaching frameworks into their professional development systems. Programs implementing EI-focused professional development may also consider how coaching support can be integrated into existing professional learning systems to ensure sustainability and scalability within authentic educational contexts.

Third, the positive child outcomes observed in this study highlight the potential of EI as an effective instructional approach for supporting the learning of young children with disabilities in inclusive classrooms. Embedding systematic instructional opportunities within everyday classroom routines may provide children with meaningful opportunities to practice target skills while participating in typical classroom activities. Increasing the frequency and quality of ELOs within naturally occurring classroom routines may enhance children's engagement and participation, thereby supporting meaningful learning within inclusive early childhood settings.

5. Conclusions

Inclusive early childhood classrooms provide important opportunities for children with disabilities to learn alongside their typically developing peers. However, ensuring meaningful participation and learning within these settings requires teachers to implement effective instructional practices that can be integrated into everyday classroom activities. The present study provides evidence that professional development models designed to support teachers' use of embedded instruction can improve both teacher implementation and child learning outcomes. By employing a randomized controlled design, the study contributes additional empirical evidence supporting the effectiveness of professional development models aimed at strengthening teachers' implementation of embedded instruction in inclusive preschool classrooms. Specifically, the findings demonstrate that workshops can increase teachers' use of EI practices, whereas workshops combined with practice-based coaching can produce even greater improvements in both the frequency and accuracy of implementation. Importantly, these improvements in teacher practice were associated with meaningful gains in children's performance on targeted learning outcomes. These findings reinforce previous research indicating that job-embedded coaching can play a critical role in helping teachers implement evidence-based instructional practices with fidelity and consistency (e.g., P. Snyder et al., 2018; P. A. Snyder et al., 2026). Together, the findings highlight the importance of sustained, practice-focused professional development supports for promoting the use of evidence-based instructional practices in inclusive preschool classrooms and for enhancing learning opportunities for young children with disabilities. Strengthening teachers' capacity to implement embedded instruction within everyday classroom routines may therefore represent a promising strategy for improving inclusive early childhood education and supporting the developmental outcomes of children with disabilities.

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