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Increasing Teacher Opportunities to Respond in a Head Start Program Using a Bug-In-Ear Coaching Model

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Abstract

Early childhood teachers play a critical role in the kindergarten readiness of preschool age children. Yet, they often receive little and insufficient training in the use of evidence-based practices that can increase academic success and prevent undesired behaviors. As a result, preschool teachers tend to use more exclusionary practices when disciplining students. A promising strategy for developing the skills of preschool teachers is the use of bug-in-ear coaching, a coaching strategy where a trained individual provides in-the-moment support to a teacher from a location outside of the classroom. This study examined bug-in-ear coaching to support preschool teachers in using opportunities to respond during explicit math instruction. A multiple baseline design across teachers was used to assess the impact of the intervention on the teachers' rates of implementation of opportunities to respond. Bug-in-ear coaching was associated with an increased rate of opportunities to respond for all teachers during the intervention with a functional relation for two out of four teachers. All teachers' rates of opportunities to respond were below their intervention rates during maintenance. Further, teachers reported enjoying the intervention and the opportunity given to improve their practices. Teachers also expressed their desire to have this level of coaching in their centers.

Keywords Bug-in-ear · Opportunities-to-respond · Exclusionary practices · Head Start teachers · Students of color

Early childhood education programs cater to the critical time when young children first begin to learn about the world and the people around them. During this time, it is essential to support young children across all key areas of development (Pianta et al., 2009). Preschool teachers play a critical role in the support of young children's development as their purpose is to provide developmentally appropriate and engaging environments and to intentionally address children's individual needs to support their learning, especially for children from under resourced and impoverished backgrounds. To remedy the different rates of kindergarten readiness between students from low and higher socioeconomic backgrounds, Project Head Start was an initiative launched in 1965 (U.S. Department of Health & Human Services, 2021). Beginning as an 8-week summer program, Project Head Start sought to provide preschool children from low socio-economic backgrounds access to an early education to address their emotional, psychological, social, health, and nutritional needs (U.S. Department of Health & Human Services, 2021). This program has since expanded into a national organization that serves children and their families in urban and rural areas across the 50 United States and territories. When early childhood centers and programs are tailored in ways that utilize trained early childhood teachers, programs and practices can often be implemented to improve services for children.

Unfortunately, not all early childhood centers and classrooms have teachers equipped to provide necessary and developmentally appropriate support, and many children are at risk of not being kindergarten ready and of receiving exclusionary practices (i.e., time-out, suspension, and expulsion; Zeng et al., 2019). For a variety of potential reasons (e.g., limited state funding, competing priorities), preschool teachers who work with young children often live in states with a low bar for training and sub-par certification

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requirements (e.g., Early Childhood Education Certificate/Credential Programs [requirement of a minimum of 120 clock hours], Child Development Associate; Whitebook et al., 2018). While the organization is increasing efforts to ensure more teachers have bachelor's degrees, the current lack of teacher training, specifically in evidence-based instructional practices, and less than stringent qualification criteria for preschool teachers is hypothesized as one reason for the high rates of exclusionary practices received by preschool students, particularly preschoolers of color (i.e., non-white students, Hubel et al., 2020).

Preschool to Prison Pipeline

Early childhood professionals are essential in the early childhood period as they have the opportunity to provide developmentally appropriate environments and respond to the individual support needs of children to expand their learning. Unfortunately, not all early childhood environments are equipped to provide such support, and many children are at risk for receiving exclusionary practices (Myers & Pianta, 2008; Zeng et al., 2019). Research has found that as early as preschool, children of color are more at risk than their peers to experience bias from teachers and negative behavioral outcomes.

In the 2017–2018 school year, Black preschoolers accounted for 18.2% of the total national preschool population but received 43.3% of one or more out of school suspensions (Civil Rights Data Collection, 2021). Multiracial preschoolers accounted for 4.1% of the total preschool population but received 6.5% of one or more out of school suspensions and Native American or Native Alaskan preschoolers accounted for 1.1% of the total preschool population but received 1.7% of one or more out of school suspensions. Black preschoolers were expelled at rates that were more than twice (38.2%) of their total population (18.2%).

The state of Texas ranks high among other states as having large rates of suspensions and expulsions beginning as early as preschool. Texas schools reported 62,557 in-school suspensions during the 2017–2018 school year among students in preschool through second grade and over 7000 out-of-school suspensions (Texans Care for Children, 2019). More specifically, Black students in these early grades in Texas were almost five times more likely to receive out-of-school suspension and more than twice as likely to receive in-school-suspension (Texans Care for Children, 2019). This is particularly problematic given that suspensions and expulsions are associated with negative educational (academic and social) and life outcomes possibly maintaining the preschool-to-prison pipeline ([PtPP], Huang et al., 2021). The PtPP can be defined as the policies, procedures, and practices within schools and classrooms, whether overt or covert, that push students in a linear path out of school and toward the criminal justice system starting as early as preschool (Green et al., 2018).

Fortunately, effective service delivery in early childhood programs can aid in the prevention of exclusionary practices such as time out and eventual suspension, and expulsion. Yet preschool teachers are not required to hold certification to deliver these services—and many do not—with the result that students are being suspended and expelled from preschool (Bueno et al., 2010; Early et al., 2007). This has initiated a pattern that has a strong likelihood of continuing throughout their schooling and leading toward negative outcomes (e.g., drop-out, engagement in juvenile justice system). Further, the challenge of classroom behavior management contributes significantly to job dissatisfaction and often factors into short tenures (Cassidy et al., 2011).

Having preschool teachers who are trained to effectively teach young students and manage their behaviors becomes even more critical given Texas' new initiative for all-day preschool that opens the enrollment cap across schools and preschool centers across the state (Allen, 2019). Ideally, professional development would be a part of every preschool program's budget, but most early childhood programs are funded at very low levels and lack resources for intensive teacher training. In fact, Hamre et al. (2017) noted that most professional development utilizing evidence-based training are typically funded through supplementary grants. The 2019–2020 annual report for the Head Start organization involved in this study confirms this trend, showing an approximate $270,000.00 allocated for training and professional development expenses in an over $50 million budget.

Increasing Teacher Use of EBPs to Reduce the use of Exclusionary Practices

Research has demonstrated that one under researched contributor to the PtPP is teachers' low rates and differential use of evidence-based practices (EBPs; Gion et al., 2020; Green et al., 2019, 2021). EBPs are strategies that result in measurable academic and prosocial gains or benefits for the population for whom they are applied. For a practice to be regarded as an EBP, it must (a) be identified through and supported by multiple high-quality studies using research designs determining causality, and (b) be proven in studies as having the highest impact on improving student outcomes (Cook & Odom, 2013). Better teacher training and support on the implementation of EBPs can increase teacher use of EBPs which yields decreases in teachers' use of exclusionary practices.

Opportunities to Respond

Teacher use of EBPs such as opportunities to respond (OTR), have been shown to increase desired student behaviors and decrease undesired student behaviors (Simonsen et al., 2008). Unfortunately, many classroom teachers have not been taught how to implement EBPs with fidelity or at the recommended rates to match students' needs (Kern, 2015). OTR can be defined as any teacher behavior that provides opportunities for students to actively respond to academic or behavioral material or requests (e.g., answering questions, counting aloud, physical demonstration; Common et al., 2020). When implemented at recommended rates (at least 3 per min), OTR can increase students' academic achievement and prosocial behaviors (Kern & Clemens, 2007).

Bug-in-Ear Coaching

A promising strategy for developing the skills of preschool teachers is the use of bug-in-ear coaching (BIE), a coaching strategy where the coach is providing in-the-moment support from a location outside of the classroom. BIE coaching has been characterized by teachers wearing a small discrete earpiece to receive live coaching sessions as they practice a new skill. BIE methods are sometimes perceived as intrusive and resource intensive; however, research indicates the immediacy of feedback received using this coaching method yields quick and effective results (Owens et al., 2020; Rosenberg et al., 2020). Further, BIE coaching has evolved from coaches being in a different area of the room (e.g., Scheeler et al., 2018) to allowing the coach to provide feedback from remote locations via video conferencing systems saving time and money (e.g., Coogle et al., 2018).

BIE methods have been implemented and assessed in various settings and with individuals in various education roles. For example, Ottley and Hanline (2014) used BIE to coach early childhood teachers to meet the communication needs of preschool children. Findings indicated teachers improved in at least one communication strategy given the large effect sizes for most participants. A similar study, conducted by Coogle et al. (2018), demonstrated that novice early childhood special education teachers' use of communication practices increased when provided coaching through a web-based BIE coaching model. BIE methods have also been implemented in K-12 settings. For example, Owens et al. (2020) used a tiered teaching intervention package consisting of BIE coaching to assess the fidelity of four general education teachers' strategy assistance for students with persistent off-task behavior. Findings indicated there was a functional relation between the intervention package and each teachers' implementation fidelity. Paraeducators have also been showed to benefit from BIE coaching. Rosenberg et al. (2020) assessed the effect of a BIE coaching package on paraeducators' use of incidental teaching for teaching self-advocacy skills to students with disabilities. Results of the study demonstrated the paraeducators increased in their accuracy and rate of incidental teaching and students increased their self-advocacy skills. As summarized by these few studies, research examining the effects of BIE coaching is a promising means for providing practitioners with in-vivo coaching within the natural classroom setting because it enhances the quality and quantity of instructional strategies that can be embedded into teachers' routines.

Current Study

According to Hamre et al. (2017), most professional development studies include methods for observation (59%) and verbal feedback (58%), many include modeling (35%) and written feedback (22%), and less frequently used methods include side-by-side verbal support (6%) and role-play (4%). Hamre et al. (2017) acknowledged progress in developing more systematic professional development including a model of practice-based coaching developed for Head Start by the National Center on Quality Teaching and Learning. However, they also noted that simply providing programs with a coaching model would not automatically lead to effective coaching. The researchers advocated training that would: (1) Target specific, focused teaching practices; (2) Be sufficiently intense to change practice; and (3) Use strategies most likely to change classroom behavior. Unfortunately, much of the training provided to teachers does not have this type of focus (Hamre et al., 2017). With Hamre et al.'s, (2017) three research-based recommendations for effective professional development in mind, we developed the current study.

The purpose of the study was to demonstrate the benefits of a real-time, bug-in-ear coaching model as a form of teacher coaching in early childhood education. The lack of an effective service delivery model (e.g., the model for instruction and classroom and behavior management adopted by the early childhood center) where evidence-based practices are implemented has significant implications for the discipline and provision of appropriate interventions and identification of young children with and at-risk for academic failure, served within early childhood programs. The following research questions were addressed:

Research Question 1	What are the effects of BIE technology on early childhood teachers' implementation of recommended rates of opportunities to respond?

Research Question 2 To what extent do early childhood teachers continue to increase or maintain their rates of OTR after the BIE technology is removed?

Method

Participants

Centers

Head Start centers within a Head Start Organization in an urban region in Texas were targeted and solicited for participation. The Head Start organization was targeted for participation because they serve a large population of students of color. Further, preschool centers are a largely under researched area in terms of teacher use of EBPs for the prevention and reduction of exclusionary practices that lead to the PtPP in early childhood centers.

Centers included in this study served infant, toddlers, and preschool children ages 2–5 years old with 100% of students from low socio-economic status homes (i.e., families of four must have a total household income at or below $25,750), and enrolled 98.5% of students of color (i.e., non-white students) across approximately 38 standalone centers or embedded locations across the geographical region. Teachers across four centers were identified as meeting the inclusion criteria (i.e., early childhood teacher of record) and upon Institutional Review Board approval were invited to participate in the study.

Teachers

Fifty general education teachers across the four Head Start Centers met inclusion criteria and were invited to participate through email. To maintain consistency across observations and allow for generalizability, all classroom observations were conducted during math whole group or circle time in classrooms for children aged 3–5. Four teachers, all belonging to the same center, participated in the study.

All four teachers identified as female and Black. The mean years of teaching experience across teachers was 12 years (SD = 9.77; range: 1 to 26 years). One teacher held a High School diploma, two teachers held an Associate degree, and one teacher held a Bachelor's degree (Table 1).

Students

Forty-four students assented and participated in the study. Student demographic data (i.e., race and gender) for all students was provided by the center at the end of the school year. Of the 44 students across all classrooms, 77.2% (n = 34) were African American and 22.7% (n = 10) were Hispanic. Twenty-two (50%) students were female, and 22 (50%) students were male. There was a mean of 11 students per classroom (*Range* = 10 to 12 students per classroom).

Materials

Teachers were equipped with the technology that was used to conduct observations and coaching sessions. Each of the participating teachers were provided an iPad, a Swivl, earbuds, a tripod, and charging and connecting cables. iPads were installed with applications (i.e., Swivl and Zoom) to be used during sessions. Teachers were also supplied with detailed instructions to operate the electronic devices and troubleshoot (if needed) the technology.

Dependent Variable and Data Collection

The primary dependent variable was teachers' implementation of group OTR at a minimum rate of 3 per minute. For the study, a group OTR was recorded if the teacher provided an OTR without explicitly calling on a student prior to or immediately after providing the OTR. For example, the question, "How many squares do you see?" could have been answered by any student in the class. Individual OTR (e.g., "Alanna, show me the number five?") were not recorded.

Table 1 Teacher demographic information

Participant	Highest degree	Years of teaching experience	Gender	Race
1	AA Degree in EC Education	1	Female	Black
2	AA Degree in Early Childhood Education + some college and child development courses	26	Female	Black
3	High school + some college and child development courses	16	Female	Black
4	Bachelor's Degree	5	Female	Black

This table describes the demographic information for participating teachers

Data collection for this measure were limited to academic OTR. As such, data were collected when the teacher provided OTR for academic content, rather than behaviorally related content to reflect its primary use (Kern & Clemens, 2007). All types of OTR were coded (e.g., verbal responses, non-verbal responses, response cards).

Using a beta version of the electronic data collection tool, Self-Equity Evaluation and Data Analysis Tool (SEEDAT), data collectors were trained to track the frequency of OTR during teacher direct instruction. Data were collected during direct, teacher-led, math instruction (including carpet time and circle time). Data were not collected if students were working independently (i.e., independent work, seat work, or centers). Due to the varied length of time allotted for math instruction across teachers, observations were conducted in 15-min increments.

Interobserver Agreement

Data collectors were hired to perform direct observation data collection during video recorded classroom observations. Six data collectors (i.e., three undergrad students, one doctoral student, and one research assistant holding a PhD, and one assistant professor) were trained to code for OTRs and were required to achieve an overall interobserver agreement (IOA) of at least 80% with the primary researcher (i.e., first author) on four different training videos during a 5-h training session. During the training, data collectors (a) were taught the operational definitions of OTR with examples and nonexamples; (b) were provided instructions for how to collect data using a paper-and-pencil coding system and SEEDAT; and (c) watched four videos of teacher-led instruction and practiced the coding system. IOA was calculated by dividing the smaller number of recorded occurrences by the larger number of recorded occurrences and multiplying by 100 (smaller number/larger number × 100).

After meeting at least 80% IOA during video practice, data collectors completed Part 2 of training (i.e., practice in vivo). In vivo practice was held in the participating teachers' classrooms during a reading/language arts instructional period. Each data collector observed one 30-min session with the primary researcher, in which IOA rates were calculated once more. If IOA was above 80%, the data collector began independently collecting data. If a data collector's IOA fell below 80%, they were retrained using the training videos and debriefed on disagreements until minimal percentages were met. The main reason for retraining was data collectors were confused between teachers providing OTR and teacher scaffolding for the same OTR.

Reliability through IOA was collected across all observations. IOA for OTR across baseline was 84.36%, 85.36% for intervention, and 83.45% for maintenance.

Experimental Design

A multiple baseline design across teachers was used to determine whether the BIE coaching method (Horner & Baer, 1978) would increase teacher use of OTR during math instruction. The teacher with the most stable and lowest baseline level entered the intervention phase first. When the first teacher demonstrated a consistent increase in use of EBPs across at least three intervention sessions, the second participant with the most stable and lowest baseline level entered the intervention phase. This process was repeated with the remaining two teachers. The intervention phases concluded after five coaching session and a maintenance phase commenced.

Analysis

Visual analysis was used to view and inspect sessions in each condition for all four participants. Through visual analysis determinations about each participants' behavior changes can be observed based on their data. When the intervention (i.e., the bug-in-ear) is implemented, there is the possibility of a potential demonstration of effect (Ledford et al., 2017). This type of analysis is typically critical for formative evaluations. As part of the visual analysis, the percentage of non-overlapping data points (PND) was calculated by dividing the number of data points that do not overlap by the total number of datapoints. That outcome was then multiplied by 100 to create a percentage. The effect size between baseline to intervention, and then baseline to maintenance were measured using Baseline-corrected Tau with the Kendall rank correlation method (Tarlow, 2017). The pretest for the baseline trend was adjusted if significant.

Procedures

PD/Initial Training

Before data collection, all teachers who were invited to participate in the study attended an 8-h in-person group professional development training, in which teachers learned from the primary researcher, how to implement three evidence-based classroom management techniques (i.e., OTR, general praise, positive specific feedback) through explicit instruction, video and face-to-face modeling, and guided practice. The primary researcher is the first author of the paper and holds a current Texas special education certification, is an associate professor of special education, has three years of public-school teaching experience, and conducts research and teaches undergraduate

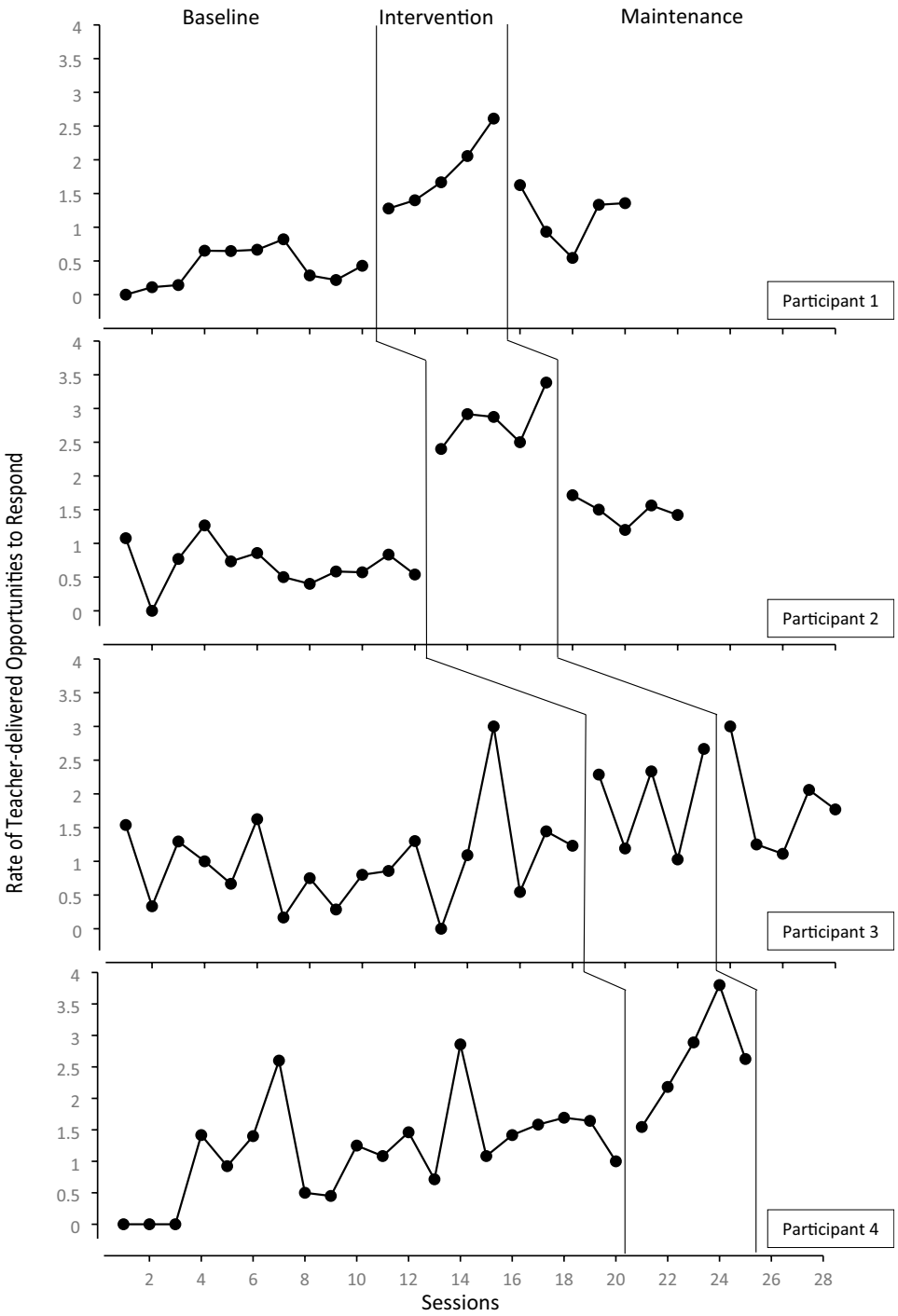

Fig. 1 Multiple-baseline across participants

and graduate students on the use of evidence-based practices to reduce discipline disparities. Specifically, teachers were taught how to identify and implement each evidence-based practice and the recommended rates of implementation as identified by research to increase academic achievement and prosocial behaviors (Fig. 1).

Baseline

During baseline, each teacher was recorded during their 15-min math lesson. Five minutes prior to their math period, teachers would use their iPad to log into Zoom, where a data collector would be waiting to record their instruction. At the designated time, teachers would begin teaching their lesson and the data collector would begin recording. Teachers would continue their lesson as usual. At the end of the

15-min lesson, the data collector would stop the recording and end the Zoom meeting.

Intervention

During the intervention, two coaches (i.e., research assistant and primary researcher) randomly assigned to a specific teacher implemented five 15-min coaching sessions using BIE. Five days was determined as the length of the intervention due to single-case research design standards for the number of data points necessary (i.e., 3–5) to determine a pattern of behavior (Ledford & Gast, 2018). The coaching sessions were held at least once a week. If the teachers' schedule allowed for multiple observations in one week, up to two sessions were conducted. Each session was recorded to allow for later data collection. The research assistant was a post-doctoral researcher with a B.Ed. in English and Social Studies, M.Ed. in Curriculum and Instruction, and Ph.D. in Educational Leadership and Policy Studies, working under the mentorship of the primary researcher and had 4 years teaching experience. The primary researcher's background was given in the PD/ Initial Training section above.

The intervention included the coach watching their assigned teachers' live math instruction and providing incremental prompts through the teachers' earpiece with a follow-up email at the conclusion of the session (see Fig. 2). The coaching protocol included the following steps: First, prior to starting their first session, teachers were reminded that the purpose of the coaching sessions were to increase their use of OTR to the recommended rate of 3 OTRs per minute. Second, while observing the teacher in-vivo, the coach set an interval timer for 15 s to prompt teachers to use an OTR.

Fig. 2 Sample of coaching feedback E-mail

Sample of Coaching Feedback E-mail

Hello (insert teacher name),

As previously mentioned, the goal of the coaching sessions is to increase your rates of asking questions (OTRs) to the rates that are validated by research to improve student academic achievement and behavior. The goal rate is **3 questions per minute**.
The feedback below is based on your coaching session from this morning.

FEEDBACK SUMMARY

Target rate (3 per minute) of Opportunities to Respond (OTR) met? *Yes. Your rate was 3.0 OTR per minute given the 15-minute observation.*

Total prompts given (How many times I said "Question" in your earpiece): *6.*

Positive Specific Feedback:

- *This is the highest your rate has been! Keep up the great work!*
- *Your rate of asking questions were consistent and great, you asked a combination of whole group and small group questions relevant to class content.*
- *During this session, students counted with you, students interacted with objects, and students verbally answered questions. Continue to think about how to provide whole group OTRs in different ways to keep the students engaged.*
- *It seemed like you prepared your questions ahead of time, this helped you keep consistency in terms of asking whole-group questions.*

Recommendations for Improvement:

- *By asking questions to the whole class, you are increasing all students' opportunities to engage in the lesson. Further, by asking questions to all students you can reduce the time that a single student could engage in off-task behaviors.*
- *Other ways to provide various types of OTRs = thumbs up/ down, raise your hand if…, stand up if…, point to…, show me…*
- *Continue to plan and write out the questions and response types before the lesson if you are not already doing so. To reach the recommended rate during a 15-minute lesson, you want to ask at least a total of 45 content related questions.*

Comments:
I understand we had some technical issues in the beginning of the lesson, but you did an excellent job of asking whole group questions. Great job!

Please let me know if you have any comments, questions, or concerns!

Sincerely,
Coach (insert name)

Every 15 s, the coach would say the word "Question" in the teacher's earpiece prompting them to ask a question to the class about what they were teaching. If the teacher already implemented the minimum number of OTRs on their own within the 15 s interval or 1-min interval, the coach did not prompt the teacher during that interval. Third, immediately after each coaching session, the coach provided written feedback through e-mail to the teacher with the teacher's rate of OTR, number of coaching prompts given during the session, positive specific feedback, and recommendations for improvement.

Maintenance

During maintenance, each teacher was recorded during their 15-min math lesson using the same steps identified during the baseline phase.

Procedural Reliability

100% (n = 20) of coaching videos were coded by the data collectors to ensure procedural reliability. When watching each intervention session, data collectors indicated whether the coach (1) was present, (2) on-time, (3) gave prompts within the correct interval, and (4) provided a feedback email to the teacher. Procedural reliability was 100% across all coaching sessions.

Results

Teacher Implementation Fidelity

As seen in Fig. 1, for each of the participants, the X axis was the rate of teacher delivered OTRs and the Y axis was the number of sessions. For the visual analysis, there were three conditions completed (i.e., baseline, intervention, and maintenance), meaning that there were two potential demonstrations of effect (i.e., baseline → intervention, intervention → maintenance). Participant 1 was in baseline for 10 sessions, Participant 2 was in baseline for 12 sessions, Participant 3 was in baseline for 18 sessions, and Participant 4 was in baseline for 20 sessions. The average amount of time all the participants were cumulatively in baseline was 15 sessions ($SD = 4.76$). After the participant's baseline stabilized, they each received the bug-in-ear intervention for five sessions. Then participants 1, 2, and 3 were in maintenance for five sessions.

For Participant 1, baseline was relatively stable with mean rates of OTR 0.40 ($SD = 0.28$; *Range* 0–0.82) and a relatively small increasing trend. During intervention, there was a clear level change and a strong increasing trend. During the intervention, the mean rates of OTR was 1.80 ($SD = 0.54$; *Range* 1.28–2.61). Between baseline and intervention, there were no points overlapping ($PND = 100\%$). During maintenance, there was a clear level change and data were moderately variable with a flat trend. Mean rates of OTR were 1.16 ($SD = 0.42$; *Range* 0.55–1.63). The PND between the intervention and maintenance sessions was 40% (two non-overlapping sessions divided by five total sessions*100). When analyzing effect size, from baseline to intervention $\tau_{BC} = 0.69$ ($SE = 0.26$) and between baseline to maintenance $\tau_{BC} = 0.58$ ($SE = 0.30$).

For Participant 2, baseline was slightly varied with rates of OTR ranging from 0 to 1.27 ($M = 0.68$; $SD = 0.33$) and a flat trend. The intervention sessions were again relatively stable, with a slight increasing trend ($M = 2.82$; $SD = 0.39$; *Range* 2.40–3.38). The PND between the baseline and intervention sessions was 100%. For the maintenance sessions, date were relatively stable, 1.20 to 1.71 ($M = 1.48$; $SD = 0.19$), with a slightly decreasing trend. The PND between the intervention and maintenance sessions was 100%. For the effect size, from baseline to intervention $\tau_{BC} = 0.66$ ($SE = 0.26$) and between baseline to maintenance $\tau_{BC} = 0.64$ ($SE = 0.26$).

For participant 3, there were little to no differences between the baseline, intervention, and maintenance sessions, with datapoints greatly varied. In the baseline session, rates of OTR were varied, ranging from 0 to 1.53 ($M = 1.00$; $SD = 0.69$), and had a flat trend. Intervention rates and trend were similar ($M = 1.91$; $SD = 0.74$; *Range* 1.02–2.67). Due to similarities in the rates of OTR, PND between the baseline and intervention sessions was 0%. The maintenance sessions were also highly varied ($M = 1.84$; $SD = 0.75$; *Range* 1.11–2.06), had high overlap in OTR rates with the intervention sessions ($PND = 0\%$), yielded a decreasing trend. The effect size from baseline to intervention was $\tau_{BC} = 0.36$ ($SE = 0.28$) and between baseline to maintenance it was $\tau_{BC} = 0.39$ ($SE = 0.27$).

The final participant, Participant 4, also had varied data with high rates of overlap between the baseline and intervention sessions. For the baseline sessions, the rates of OTR implemented ranged from 0 to 2.86 ($M = 1.15$; $SD = 0.77$) and yielded an increasing trend. For the intervention sessions, the rates of OTR implemented ranged from 1.55 to 3.80 ($M = 2.61$; $SD = 0.84$) yielding an increasing trend. To demonstrate the high rates of overlap, PND was 20%. In addition, the effect size from baseline to intervention was $\tau_{BC} = 0.32$ ($SE = 0.27$).

Table 2 Describes the social validity data for opportunities to respond (OTR) teachers

Question	Participant	Response
Reflecting on your overall experience participating in the Pre-School Lab Project, what do you think went well?	1	The overall communication between the teacher and the students, and the helpful feedback from the research team. Plus, the engagement some of the children had during the lessons
	2	Somewhat
	3	With me being observed made me ask the children more open and ended question
	4	I think the overall experience went wonderful especially the coaching portion of the observations
Reflecting on your overall experience participating in the Pre-School Lab Project, what do you think was challenging?	1	The ability to be able to hear through the earpieces when I needed to ask the students a question, and keeping some of the students focus during the learning process. Keeping most of the children focused
	2	Nothing
	3	Asking the children so many question per min
	4	As with any preschool classroom the challenge was keeping them focused on me and not the camera
What was challenging about implementing OTRs?	1	Trying to keep the students focused on the lesson they were being taught
	2	Nothing
	3	It made me stay focus
	4	N/A
What went well when implementing OTRs?	1	A lot of the students that participated in the lesson answered questions timely and accurately. How much more the children learned during each lesson
	2	Communication
	3	Having it
	4	Giving them “clues” when they were stuck as opposed to just answering for them
Did you see any changes in desired student behaviors (e.g., interacting, listening, responding) when implementing OTRs? If so, please explain	1	Yes, I observed students that usually showed no interest in learning listening to the teacher, interacting within the lessons and providing responses to questions. They listened more and responded to questions more. There was a lot of interaction during each lesson. I had children that usually don't participate in the lesson really show interest
	2	No
	3	Yes the children that had behaviors started interacting in the large group
	4	They were more engaged and more eager to respond. They didn’t seem frustrated
What was challenging about the coaching sessions?	1	I was not sometimes able to hear the coaches through the ear pieces
	2	Nothing
	3	Telling me when to ask question per min
	4	N/A
What went well during the coaching sessions?	1	The feedback that I was provided which helped me throughout the process to get better each time I gave a lesson
	2	Communication
	3	Nothing
	4	The coaching sessions were so helpful. Like extremely helpful. I learned that asking more questions and scaffolding more really helps the children respond and be more engaged

Table 2 (continued)

Question	Participant	Response
What did or didn't you like about the feedback emails?	1	I liked my feedback emails they helped me a lot
	2	The feedback was positive at times
	3	The emails were informative
	4	I ENJOYED the feedback emails. I work better when I can see what I'm doing and how I can improve

This table describes the participants response provided through the social validity questionnaire

Social Validity

Teachers completed a social validity questionnaire using eight open-ended questions at the conclusion of the study to determine usefulness and effectiveness of the intervention. All teachers reported favorable associations with the study and strongly expressed their appreciation for the feedback given during the intervention phase. However, teachers cited issues with technology being their most unfavorable concern. See Table 2 for teacher responses.

Discussion

The purpose of this study was to demonstrate the benefits of a real-time, BIE coaching model as a form of teacher coaching in early childhood education with the overall goal to assist in the reduction of teachers' dependence on exclusionary practices (e.g., time-out, suspension, expulsion) and ultimately reduce preschool students' entry into the PtPP. The results of this study align with previous research demonstrating BIE technology can assist in increasing early childhood teacher use of targeted practices (Ottley & Hanline, 2014). Results also align with previous research indicating mixed effectiveness of the BIE technology. For example, while two teachers in the study demonstrated a functional relation between BIE and their rates of OTR, the third teacher's data remained variable during all three phrases of the study, like results found in Ottley and Hanline (2014). The fourth teacher's data were trending upward but due to attrition, maintenance data could not be collected, and a functional relation could not be assessed. Nonetheless, research focused on early childhood education programs suggests that when these programs provide continuous learning opportunities to early childhood teachers, they are more likely to have teachers who can demonstrate higher quality instruction that enhance children's learning (Ehrlich et al., 2018).

Most encouraging is the social validity data from the participating teachers. The teachers indicated that the BIE coaching model was helpful to improving their teaching practices. Further, they perceived students were more engaged in the lesson during the intervention phase. These findings have potential implications for early childhood teachers' recruitment, retention, and job satisfaction (Crammer & Cappella, 2019; Wells, 2015).

Limitations

As with all research, the study is not without limitations. First, the study was conducted during the 2021–2022 academic year, affected by a Pandemic, and when schools were beginning to ease back into in-person instruction for children. This time was indicative of several COVID-19

precautions and protocols from the participating centers and the University Institutional Review Board. Second, the use of technology in classrooms was a challenge. The Swivls were not always placed in appropriate locations to see all students and teachers properly, teachers would accidently mute the audio on the iPads, earpieces fell out of some teachers' ears, some buildings had unstable internet that yielded momentary delays or interruptions during sessions, and there were untimely software updates. Third, Teacher 3 could not complete her maintenance observations due to an injury that did not allow her to return to work for the remainder of the year. Fourth, student attrition across years made it difficult to compare data from year to year (e.g., pandemic related, mobility). Therefore, student academic data were not assessed in the study. Fifth, the quality and level (e.g., factual, interpretive/inferential, analytical, critical, creative) of questions were not notated in the study. Future research should seek to include various types of questions when implementing OTR.

Recommendations for Practice

Given the results of the study, there are two critical recommendations for practice. First, preschool teachers would greatly benefit from professional learning and ongoing coaching on the use of EBPs. All teachers in the study demonstrated a desire to learn more about effective practices for increasing students' academic achievement and prosocial skills. Further they all communicated their appreciation for the live coaching support and feedback cycle. As in many k-12 grade settings, a designated instructional coach (e.g., doesn't split roles) can be utilized to support the ongoing cycle of coaching and feedback required to improve teachers' practices and in turn yield positive student outcomes. Second, early childhood centers should set aside more funds to support teacher development. Having preschool teachers who are trained to effectively teach young students, with or without disabilities, and manage their behaviors becomes even more critical given Texas' new initiative for all-day preschool that opens the enrollment cap across schools and preschool centers across the state. Ideally, professional development would be a part of every preschool program budget, but most early childhood programs are funded at very low levels and lack resources for the kind of support previously recommended (Hamre et al., 2017). In fact, Hamre et al. (2017) noted that most professional development utilizing evidence-based training were typically funded through supplementary grants. The 2019–2020 annual report for the participating Head Start organization in this study confirmed this trend, showing just $279,129 allocated for training and professional development expenses in an over $50 million budget.

Recommendations for Research

Due to the varied results from the BIE technology intervention, there are multiple recommendations for this research. First, it is important to replicate this work, and potentially replicate this work with a larger sample size, which could welcome different research methods. For example, future research could design a randomized control trial, where teachers are randomly assigned into either an experimental (i.e., bug-in-ear intervention) or control group (i.e., business as usual). If conducted with high levels of validity, this future research could help us determine whether the bug-in-ear-intervention potentially caused increased rates of teacher OTR implementation and could potentially help researchers link the bug-in-ear intervention to other teacher and student outcomes.

Second, this research study was purely focused on the rate teachers implemented OTR in their classrooms. Future research could focus on measuring how the students responded to the increased use of OTR, specifically analyzing student outcomes such as academic achievement or behavioral changes. These data could help us better understand the effectiveness using increased rates of OTR in the classroom and could help us better understand whether the BIE technology was associated with student outcomes through changes in teacher practices.

Data from this study demonstrate the importance of investing in coaching supports for early childhood teachers and their desire for support with effective classroom management practices. Given that BIE technology has been proven to increase teacher use of EBPs individually and collectively, more research is needed to adequately assess how effective BIE technology is in early childhood programs where teachers' credentials are limited or non-existent to better understand the relationship between patterns of EBP implementation and high rates of exclusionary practices among preschool students of color.

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Declarations

Conflict of interest We have no known conflicts of interest to disclose.

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